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Department of Economics

How Could Agricultural Trade Between Ukraine And The EU Benefit From Institutional Harmonization?

- A Regression Discontinuity Approach

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Declaration

I hereby affirm that the present thesis with the title "How Could Agricultural Trade Between Ukraine And The EU Benefit From Institutional Harmonization?" was prepared by myself alone and did not involve the use of any impermissible help or of any other tools than the ones indicated. All parts of the text – including tables, maps, figures, etc. – which were taken over verbatim or analogously from other published or unpublished works have been identified accordingly. The thesis has not yet been submitted in the same or a similar form within the context of another examination, and has not been published either in part or in its entirety.

Uppsala, June 16, 2014

Uliana Rusetska

Abstract

Trade liberalization as a part of European integration has been on the Ukrainian agenda for years and resulted in the finalized Deep and Comprehensive Free Trade Area (DCFTA) agreement with the EU, though yet to be signed. This thesis aims to contribute to the previous assessments by approaching the issue of institutional alignment of Ukraine to the EU's *acquis* stemming from the "deep" aspect of the DCFTA. The "small shares" problem inherent in previous applications of the Computable General Equilibrium model to study Ukraine-EU trade liberalization is addressed here by estimating potential Ukrainian exports of currently negligibly traded meat and dairy products with the EU. This is done by applying the Sharp Regression Discontinuity design to estimate the treatment effects from a representative adjustment experienced by the New Member States of the EU. The findings reveal a significant positive discontinuity of exports for new EU members for all meat and dairy product categories with particularly large increase of bovine products' exports. Final calculations demonstrate the most pronounced potential growth of Ukrainian exports to the EU to accrue for animal products as well as milk and dairy produce, up to 149 and 33 million Euros respectively.

Abbreviations

AA	Association Agreement
CEEC	Central and Eastern European Country
CIS	Commonwealth of Independent States
DCFTA	Deep and Comprehensive Free Trade Area
ENP	Eastern Neighborhood Partnership
EU	European Union
FTA	Free Trade Area
GSP	Generalized System of Preferences
NFN	Most Favored Nation
NMS	New Member State
NTB	Non-Tariff Barrier to trade
RDD	Regression Discontinuity Design
SRDD	Sharp Regression Discontinuity Design
SPS	Sanitary and Phyto-Sanitary measures
TBT	Technical Barriers to Trade
WTO	World Trade Organization

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CHAPTER I – INTRODUCTION

1.1 Background

An eastern neighbor of the European Union (EU), Ukraine has seen its economic, trade and political ties with the EU intensifying over the last decade since its independence. The Partnership and Cooperation Agreement in force since 1998 formalized relations including trade between the two partners. The agreement introduced the Most Favored Nation (MNF) principle in bilateral trade with Ukraine, encouraged Ukraine to adapt its legislative basis to that of EU and envisaged potential Free Trade Agreement (FTA) discussions in case Ukraine advances in its economic reforms. However, it lacked sufficient incentives to foster regulatory and institutional harmonization of Ukraine with the EU. Following the Orange revolution of 2004 further pro-European democratic and economic integration has become more central to the political agenda of Ukraine. In 2005 EU-Ukraine action plan stressed the importance of even closer political and economic cooperation of the two economies. Ukraine was granted the status of a market economy that year. Establishment by the EU of the Eastern Partnership with Ukraine as well as Armenia, Azerbaijan, Belarus, Georgia, Moldova in 2008 implied further impetus for development in the three dimensions: the Association Agreement (AA) and the agreement on a Deep and Comprehensive Free Trade Area (DCFTA); facilitation of the visa regimes and long-term visa liberalization, as well as readmission agreements (Movchan and Shportyuk, 2012).

Obtaining World Trade Organization (WTO) membership in 2008 has opened the door for official negotiations of the deep(covering behind-the border trade barriers by means of regulatory harmonization to the EU) and comprehensive (including various issues in trade in goods and services) free trade area or as it is sometimes called- free trade "plus". Ukraine has advanced most in the negotiations of the DCFTA among the Eastern Partnership countries and in 2012 the Association Agreement and the DCFTA were initialed. The agreed upon agreement goes beyond tariff reductions. It encompassed multiple provisions for opening of the EU market via progressive removal of customs tariffs and quotas as well as alignment of legislature, norms and regulations governing diverse trade related sectors. The final document of DCFTA consists of 15 chapters, 14 annexes and 3 protocols according to the European Commission (n.d.(a)). The DCFTA part of the Association Agreement incorporates multiple policy fields:

1. Market Access for Goods. This foresees immediate removal of majority of customs duties on goods after agreement entering into force and overall elimination of 99,1% of duties in trade value by Ukraine and 98,1% by the EU, according to the EC (n.d.(a)).
2. Non-Tariff Barriers (NTBs) on trade in goods will coincide with such WTO rules regarding NTBs as national treatment, prohibition of import and export restrictions, disciplines on state trading etc. Export duties will be prohibited immediately with few

exemptions for Ukrainian metal and agricultural products. Duty-free tariff-rate-quotas for several sensitive products and transition periods are also envisaged for Ukraine.

3. Trade Remedies. Diverse trade defense mechanisms are incorporated including anti-dumping, anti-subsidy duties and global safeguards.

4. Technical barriers to trade (TBT). Technical regulations, standards, conformity assessment procedures and similar requirements are to be simplified and progressively adapted by Ukraine to those of the EU reiterating commitments under the WTO. The European Commission estimates that such "harmonization and/or mutual recognition of technical standards should cut existing non-tariff barriers in the agri-food sector by half and 35% in other sectors compared to 2004" (EC, n.d.(a), p.4).

5. Sanitary and phyto-sanitary measures (SPS). The parties would prepare and sign a veterinary and phyto-sanitary chapter. Legislature in animal welfare and SPS measures would be aligned between Ukraine and the EU and conform to the principles of the WTO/SPS Agreement. A rapid consultation mechanism on SPS measures and a rapid alert and early warning system would be established.

6. Customs issues and trade facilitation. This broadly includes simplification of customs requirements, closer cooperation and mutual assistance on customs matters, information exchange and a temporary withdrawal of preferences as a safeguard in the event of insufficient cooperation.

7. Establishment, trade in services and electronic commerce. This section involves what the European Commission has called "the unprecedented level of integration" (EC, n.d.(a), p.5). Non-service sectors as well as various services like financial, telecommunications, postal and courier, and international maritime services will face legislative alignment, which once finished will grant Ukrainian firms access to the European market and facilitate investment into these from the EU due to similar regulatory environment.

Other chapters encompass various aspects such as current payments and capital movement, public procurement, intellectual property, market pricing of gas and electricity, transport and transit of energy goods, non-discriminatory access to exploration and production of oil and gas, establishment of independent energy markets, competition and efficiency regulation, transparency, trade and sustainable development, dispute settlement, and mediation mechanisms.

1.2 Problem statement

The comprehensive and deep nature of the potential FTA suggests the broad scope of its possible economic impacts extending way beyond the bilateral tariff reduction also known as "shallow integration". A bulk of economic outcomes is likely to stem from the "deep integration" component of the DCFTA agreement, which implies the alignment of

legislature and to the EU's non-negotiable *acquis communautaire*[1]in order to access the single European market. For Ukraine, the DCFTA is anticipated to open the door for agricultural products not exported before or in limited quantities because of quality shortcomings, incompliance to the European sanitary and phyto-sanitary requirements or other existing NTBs. Indeed, NTBs such as TBT and SPS measures can substantially impede trade and have been found to be more import restricting in the EU compared to other OECD countries (Disdier et al., 2008). The removal of non-tariff impediments is particularly relevant for the Ukrainian agriculture sector, which accounts for a significant share of Ukrainian DGP and of trade flows with the EU. Non-tariff harmonization may further allow for increased exports of more processed food products with higher added value compared to current exports of mostly raw agricultural products such as grains. The institutional change from the DCFTA, which is harmonization of Ukrainian standards, regulations and norms to the EU's *acquis* and subsequent mutual recognition, is envisaged to boost trade between the EU and Ukraine. Despite coming at a cost from adjusting the standards, meeting the quality requirements and adhering to the EU procedures, DCFTA is likely to increase exports for Ukraine in terms of traded quantities and in value due to trade of more processed goods, stimulate production and result in higher welfare. The agreement may well bring additional benefits based on ethical considerations relating to higher animal welfare and transparency of products' origin and quality for informed consumer choice. Therefore, given the "deep" component of the DCFTA, this thesis aims to answer the following research question: *What effects would institutional harmonization between Ukraine and the EU have on Ukrainian exports of agricultural products limited in trade with the EU?*

and additional sub-questions:

- Which Ukrainian product groups face small or zero trade with the EU?
- How did the institutional harmonization affect the exports of New Member States (NMSs) at the time of accession in 2004?
- How did the effects on exports from institutional harmonization differ among the NMSs and products?

To answer these questions, I will apply the Sharp Regression Discontinuity Design (SRDD) to econometrically estimate the jump in exports of the NMSs at the time of their institutional adjustment to the EU's *acquis*. I am interested in observing this discontinuity of exports for selected product groups with small or zero trade flows with regard to year threshold around which the institutional adaptation took place and apply these estimates as proxy for the impact Ukraine will face after commencing the harmonization process. I will, thereafter, calculate the predicted change of Ukrainian exports for selected product group categories – bovine animals, bovine meat, raw milk and dairy, meat products and

[1]The *acquis* implies the set of EU Directives, regulations and all the other legal texts enforced by all the EU Member States.

animal products. The new export values are estimated with the idea that they could be used to augment a Computable General Equilibrium (CGE) model for assessment of the macroeconomic effects. However, such CGE simulations are out of the scope of this thesis.

From a scientific perspective, the contribution of this research is two-fold. Primarily, it aims to address the "small shares stay small" problem inherent in the main body of literature on the EU-Ukraine DCFTA, which is based on CGE modeling. The problem implies that analyzing the trade and welfare effects based on extrapolated data from previous years may underestimate the implications of the policy in the case when initial flows were zero or small. Thus, I look at an alternative way of addressing the issue of small shares by econometrically estimating the potential post-harmonization trade flows, which could represent a new baseline for modeling. Secondly, this thesis complements the literature on the effects of European enlargement by applying recent developments in econometrics, namely the regression discontinuity design. Thirdly, the focus on specific food and agricultural product categories will further provide sector-specific analysis in addition to previous assessments of general economy-wide studies of the FTA with the EU. From the socio-political standpoint, my economic ex-ante assessment of the effects of institutional change on agri-food trade is also relevant for Ukraine given the significance of the agricultural sector for its recently deteriorating economy, the versatile pro-European aspirations of authorities and population, as well as high level of public awareness of the free trade area in question. Namely, the support for the DCFTA and the implied progress in European integration even prompted the unprecedented outburst of protests in Ukraine after a decision by the President in 2013 to suspend talks with the EU regarding the signing of this agreement after years of negotiations. These national manifestations in favor of the association agreement and its trade component highlight the need for further research regarding their potential impacts as to provide more scientific guidance for decision-makers in Ukraine. The findings may also be of interest for the other European Neighborhood Policy countries conducting negotiations and assessments of similar ambitious trade agreements with the EU.

1.3 Research hypotheses

This research poses the following three hypotheses:

(H1) Currently exports of meat and dairy products from Ukraine are limited in trade with the EU due to non-tariff trade barriers and institutional differences;

(H2) Ukrainian exports of meat and dairy products would increase substantially after the institutional harmonization of a similar magnitude to the one faced by the NMSs;

(H3) There exists a discontinuity in the exports of meat and dairy products from the NMSs to the rest of the EU at the time of adjustment to the EU's *acquis communautaire.*

1.4 Objectives

By undertaking an ex-ante analysis of Ukrainian trade liberalization with the EU through econometric estimation of the treatment effect from institutional harmonization for the NMSs this thesis aims to achieve several objectives: (i) to identify the product categories in the agriculture and food sectors with zero or small values of Ukrainian exports to the EU; (ii)to obtain the regression discontinuity estimates for the treatment effect from the institutional change occurring around the time of EU accession for the NMSs and explore its heterogeneity among the countries; (iii) to predict the export values for the identified product groups for Ukraine after the legal harmonization implied by the EU-Ukraine DCFTA.

1.5 Limitations

Predicting Ukrainian potential exports due the complex legal harmonization has called for a novel approach to be applied using the treatment effects for the NMSs. This method while being the most direct to obtain the growth estimates needed to make predictions for a set of barely traded goods is however subject to limitations. The internal validity of the study relies on assumptions implied by the context of the research question and the choice of the regression discontinuity design applied to answer it. I will thus look at the issue of comparability of the DCFTA to the process of institutional change undertaken by the NMSs. I will also address the assumption of continuity required for the RDD to show that the change in exports for the NMSs is attributed to the legal alignment and not to other changes occurring simultaneously. However, the predicted Ukrainian exports should be interpreted as such giving an approximation of the potential direction of the effects and the relative magnitude of them among the products, instead of offering specific forecasts. Furthermore, this thesis employs an econometric approach, intended to offer inputs for potential simulations in a CGE framework, but does not apply these due to its limited scope. Neither have I focused on potential trade effects for third Parties. Finally, I examine the effects on only the agricultural and food exports due to their significance for the economy and exposure to inhibiting non-tariff-trade barriers.

This thesis is structured as follows. Chapter II discusses the trade regime between Ukraine and the EU and previous studies of their FTA. Chapter III lays out the theoretical considerations behind Armington trade model of product differentiation on the demand side, its problem arising from non-tariff trade barriers and approaches to estimate them. Chapter IV shows the graphical evidence of the treatment effect and validity of RD assumptions. Chapter V reasons the choice of the RD design and describes it and its econometric specification. Chapter VI discusses the estimation results, sensitivity analysis and checks of the employed model. The predicted export values for Ukraine are also calculated and compared to other studies. I end by summarizing the approach and main findings, offering policy recommendations and suggestions for further research.

CHAPTER II – STATE OF THE ART

When approaching the analysis of a highly debated policy such as the DCFTA between Ukraine and the EU it is useful to examine the existing trade patterns between the Parties and relevance of the non-tariff impediments to trade. To ensure complementarity of this thesis and to fill in the current knowledge gaps I will also consult the existing literature assessing the establishment of the FTA with the EU, applied methodologies in these evaluations, their key findings as well as shortcomings.

2.1 Outline of the trade regime between Ukraine and the EU

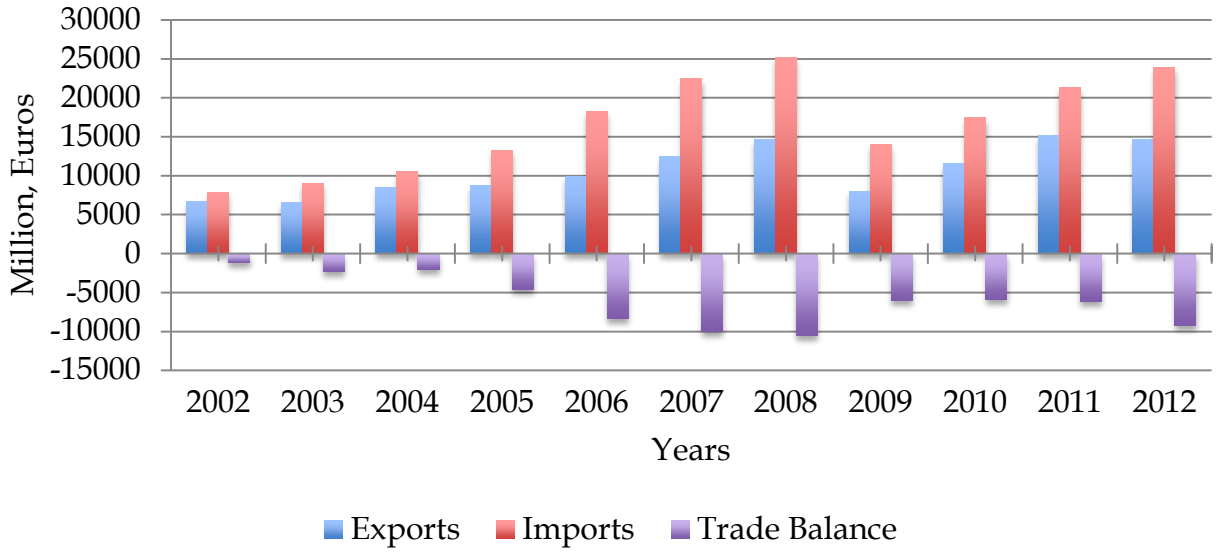
Ukraine is an Eastern European country endowed by largest in Europe land resources and a sizable, although decreasing population of over 45 million. Since the breakdown of the Soviet Union it has been striving to recover its economy from early post-communist depression. It is now classified as a lower middle-income country according to the World Bank with a slowly growing at 0,2% in 2012 GDP of 176,3 billion USD compared to growth of 5,2% in 2011 (WB, 2014a). The highest contribution to GDP belongs to service sector - 59,1%, followed by industry – 31,4% and agriculture with quite high contribution of 9,5% of GDP (CIA, n.d.). As witnessed by the significant share of the agriculture in the country's economic performance, the role of the sector is quite substantial and has been only amplified in the years of the economic crisis with soaring agricultural commodity prices. The potential of agri-food sector for responding to world food challenges is large due to suitable soil and climatic conditions, moderate labor costs. Indeed, so far Ukraine has been a net agricultural exporter primarily of cereals, vegetable oils, oilseeds and dairy products. Yet agricultural potential has not been tapped due to quality limitations, depressed farm incomes, lagging modernization within the sector, as well as non-transparency in land ownership and registration (WB, 2014b).

Continuous budget deficit and large external debt have also further escalated macroeconomic instability over the recent years, hampering the sector's support and tax-refunds. A country with very high energy-intensity of GDP and lack of sufficient domestic deposits to meet energy needs Ukraine has been dependent on the imports of primarily natural gas from Russia. This has been posing a threat to national energy security, economic stability and geopolitical situation. Located between the EU and the countries of the Commonwealth of Independent States (CIS) including Russia, Belarus and Moldova, Ukraine has been confronted with an option of joining the Russian-led Customs Union involving also Belarus and Kazakhstan. However, the evolution of its relations with the EU has also culminated in described negotiations of the free trade area.

The EU has been a key trading partner for Ukraine. It accounted for 24,8% of the value of Ukraine's total exports in 2012, second after the CIS countries, which accounted for 36,8% of exports, of which Russia made up 25,6%. The EU is also the second largest exporter of goods to Ukraine with a share of 30,9% in 2012, after CIS countries, which

exported 40,7% of the value of Ukraine's imports. Russia comprised the majority of this value, 32,4% of all imports, largely due to supplies of natural gas. The trade with the EU has been characterized by increasing trends except for the downturn of 2009. Imports from the EU have been larger in value than exports, causing the persistent negative trade balance as can be seen from the Figure 1.

Figure 1 Ukrainian trade flows to the EU



Source: Own calculations based on Comext database of Eurostat (no date)

The composition of trade with the EU is further shown in the Table 1. We can see that in 2012 Ukraine has been exporting most of all manufactured goods and crude inedible materials. Food and live animals product lines representing agriculture and processed foods in the SITC product classification made up a significant share of Ukraine's exports to the EU – 16,2%. The share of agri-food commodities exported has been increasing in the recent years compared with the average share over the last decade - 5,8%. On the other hand, the EU is the supplier of mainly machinery and transport equipment, followed by chemicals and related products as well as manufactured goods. This highlights the differences in trade patterns with Ukraine importing more value-added goods and exporting less processed products.

Ukraine's exports to the EU are subject to the EU's Generalized System of Preferences (GSP), which Ukraine joined in 1993. GSP allows applying reduced, preferential or zero tariffs to goods, which were produced or manufactured in a beneficiary country, have the proof of origin and are directly transported to the EU. GSP to Ukraine offers more modest trade concessions than enjoyed by other countries like Moldova or Georgia through the Autonomous Trade Preferences and GSP+ systems respectively and which enable lower tariff levels than in Ukraine. However, Ukraine has had a high percent of using its GSP preference. In 2010 according to the European Commission 72,2% of the eligible products

of Ukraine were imported under the GSP, ranking Ukraine 12th among the most effective users of the EU's GSP (Dabrowski and Taran, 2012). The imports under this preferential scheme to the EU include machinery and mechanical appliances, plants, oils, base metals, chemicals and textiles.

Table 1 Commodity group shares in Ukrainian bilateral trade with the EU

Product	Exports of Ukraine			Imports of Ukraine		
	2012	2002	2011	2012	2002	2011
	Value (Mio Euros)	Share (%)		Value (Mio Euros)	Share (%)	
Food and live animals	2368	16,2	5,8	840	6,9	5,3
Beverages and tobacco	19	0,1	0,2	142	1,0	0,9
Crude materials, inedible, except fuels	3032	20,7	17,4	278	2,1	1,7
Mineral fuels, lubricants, etc.	1490	10,2	14,5	626	7,5	3,9
Animal and vegetable oils, fats and waxes	642	4,4	3,2	35	0,3	0,2
Chemicals and related products	685	4,7	6,5	2585	19,3	16,
Manufactured goods	3812	26,0	33,6	2760	14,5	17,
Machinery and transport equipment	1547	10,6	8,8	6493	37,2	40,
Miscellaneous manufactured articles	567	3,9	5,8	1827	9,6	11,
Commodities and transactions	35	0,2	0,8	189	0,6	1,2
Total	1464	100,0	100,0	15927	100,0	100

Source: European Commission (2014)

On May 16, 2008 Ukraine joined the World Trade Organization (WTO). This marked the beginning for scheduled import and export tariff reductions for all products, elimination of specific tariffs and maintaining only ad valorem rates, elimination of all customs duties different from ordinary customs duties and standard safeguard measures, the commitment not to use export subsidies, elimination of the obligatory minimum export price, and the acceptance to keep trade distorting measures in the limit of 0.6 billion USD (Nekhay et al., 2012). According to the WTO the simple average MFN tariffs of Ukraine are bound at average 5,8% for all products, 11% for agricultural products and 5% for non-agricultural products. The actual tariffs are even lower: average 3,5% for all products, 9,5% are for agricultural products and 3,7% for non-agricultural products in 2012 (WTO, n.d.). The WTO accession led to decrease of previously high level of protection of some agricultural commodities such as pork, poultry and sugar and to the

elimination of all export duties except for oilseeds, live animals, hides and skins. Export duties for "live bovine animals" and "live sheep and goats", were however reduced to 50% with the WTO accession and continue to decrease to 10%. Export duties for hides have been decreased to 20% from 30% (Chauffour et al., 2010). Ukraine also uses export quotas in cases of low domestic harvest or high international prices. WTO accession implied commitments to reform technical regulation system and align Ukrainian technical regulations to international and European standards by the end of 2011 (DG, 2012). However, as reported by the State Committee for Technical Regulation and Consumers Protection as of the end of 2010 only some 25% of Ukrainian national standards were harmonized with those of the EU and international ones (Movchan and Shportyuk, 2010). Overall the trade regime with the EU following the WTO accession maintained several tariff and especially non-tariff barriers to trade (NTBs). The most important of those NTBs are standards and regulations comprising technical barriers to trade and sanitary and phyto-sanitary measures, particularly in the spheres of food products. Other relevant for Ukraine distorting NTBs include customs procedures, government procurement rules, regulatory policy and others (DG, 2012).

Ukraine also applies several NTBs on its imports. Interested reader may wish to consult a comprehensive assessment of these by Movchan (2003). While from the side of the EU, an interview-based study by the BIZPRO in a 2005 survey revealed the trade impeding issues faced by Ukrainian exporters to the EU to be: irregular and partial VAT refund (29,9% of companies), customs procedures (21,9%), inefficient and changing legislation (16,6%), and large number of procedures and permits etc. (12,6%), technical regulations and standardization (4,2%), special tariff, quotas, and duties (0,5%). Another study of the NTBs faced by Ukrainian exporters to the EU by Jakubiak et al. (2006) surveyed 510 exporters, 55% of which were rather small and 62% owned by private Ukrainian capital. The EU customs procedures were assessed to not pose a barrier to trade for over 72% of firms and as not costly by most of the firms, averaging at 6% of export value. The Ukrainian customs procedures, however, brought up more criticism. Technical standards, that imply any formal and informal norms regarding the characteristics of production or production process that producers have to observe in order to be able to sell in the market, had to be complied with by 92,8% firms selling in the EU market. About 47% of small Ukrainian-owned firms and 46% of small foreign-owned firms considered the costs of meeting the EU technical standards as higher or significantly higher. Exporters of agricultural products regarded domestic and foreign technical standards to be very different. Among agricultural exporters EU standards were found to be more or significantly more expensive than domestic by about 63% of companies. Product quality standards are shown to be the most important for all types of commodities except for food products. Trade of food products is most restricted by requirements for labeling and marking, testing and certification. Product quality standards are, however, perceived as

restrictive by about 45% of agricultural products exporters. For agriculture and food exporters the costs of complying with EU's norms were about 11-12% of yearly production costs. The presented trade patterns highlight the development of trade relations between Ukraine and the EU. Agricultural products in particular have the potential to gain a larger share in EU's imports. However, vast NTBs restrict the export potential of Ukraine and are thus interesting to explore in the context of potential FTA between the partners.

2.2 Literature on the EU-Ukraine FTA

The negotiations of the Ukraine-EU DCFTA have already prompted a body of research of its potential impacts. The CGE modeling framework has been most applied to evaluate various effects of this policy. However, many of the existing studies have been conducted based on the pre-WTO accession data before the final extend and provisions of the agreement were finalized. Moreover, the data preceding the 2008-2009 financial, food and fuel crises has been employed. Therefore, some findings should be interpreted with caution and as such giving a general indication of the potential impacts and taking a broader macroeconomic focus.

A pioneering study by Brenton and Whalley (1999) evaluated the economic impact of establishing simple FTA between the EU and Ukraine. Emerson et al., (2006) followed the model of Brenton and Whalley (1999) and employed the CGE modeling framework to assess the effects of the simple and deep FTA between the EU and Ukraine. They covered also Central and Eastern as well as Southern-Eastern European States (CEES and SEES), Russia and rest of the world. Their model based on the 2001 data delivered positive predictions of welfare increase for Ukraine of 4-7% based on comparative static simulations, while considered dynamic effects, welfare could double or triple. The long-term welfare gains for the EU-15 are more modest - 0,03%,and 0,2% for 2004 NMSs. Emerson et al. (2006) estimated ad-valorem equivalents of non-tariff barriers from the gravity model, where NTBs are represented by coefficients of dummy variables for relevant country groups. Decreased level of NTBs was modeled by raising Ukraine's export share parameter to the EU in proportion to estimated ad-valorem equivalents of the NTBs. The estimates from gravity model suggest that south-eastern EU enlargement increased trade flows for Ukraine by 2% in the short-run and 4,8% in the long run. Aggregate agricultural sector exports from Ukraine due to the DCFTA were estimated to increase by 5,1% to 31,2% in the short- and long-run respectively compared to the simple FTA.

Ecorys and CASE-Ukraine (2007) Global Analysis Report for the EU-Ukraine Trade Sustainability Impact Assessment study for the European Commission presents three simulated FTA scenarios, all including WTO accession. The deep and comprehensive FTA scenario is of particular interest for us. The extended FTA scenario included: phasing out of import tariffs for the EU-Ukraine bilateral trade as well as substantial NTBs reductions in addition to that expected under the WTO scenario. Standard costs are reduced by 50%

for agri-food and 35% for other sectors relative to the benchmark period level of 2004 (by 20-35 p.p. relative to the post-WTO level) while we expect border costs to fall by 50% also. We expect that even if the optimistic scenario is implemented, some types of trade restrictions will still remain in place" (Ecorys and CASE-Ukraine, 2007, p.74). Particularly the employed NTBs reduction amounted to 30% in agriculture, forestry, fishing, and food manufacturing sector and 15% reduction in other manufacturing sectors. The initial standard costs were used from the study with survey data on NTBs faced by Ukrainian exporters to the EU (Jakubiak et al., 2006). Overall, the authors of the extended FTA simulation also kept the 2004 tariff structure as the initial point for the modeling since they expected reduced tariffs due to WTO conformity in 2005-2006 to have tangible results occurring several years after. The study concluded that the most extensive liberalization scenario brings most welfare gains to Ukraine compared to more limited ones. Unlike for the EU and other countries including Russia, output of Ukraine has been shown to increase significantly in several sectors, especially those with remaining potential for liberalization after the WTO accession. However, production in agriculture was noted to not change substantially due to large effect already incurred from WTO induced liberalization. In terms of not only the percentage change of output but also the size of the sectors the authors highlight absolute losses in production of processed rice and sugar among the agricultural commodities. The effects on exports larger than 10% have been only positive for Ukraine and showed limited evidence of trade diversion on Russia. Imports of Ukraine have also been shown to increase as expected from trade liberalization. Overall estimates indicated short run welfare gains from "extended" FTA of 2,26% and the long run cumulative gains – of 5,29%. While, for the EU 27 the respective estimates were 0,03% in short run and 0,07% in long run. Agriculture was identified among the key economic sectors for the effects of the agreement based on its importance for the EU-Ukrainian economic partnership, the estimated economic impacts, the effect of change in production structure on social and environmental sustainable development and consultations with civil society and key stakeholders.

Francois and Manchin (2009) estimate the effects of trade liberalization between the EU and the CIS countries with a CGE model based on data up to 2004 and incorporate the NTBs only to trade in services. Their results show contrasting negative prospects for Ukraine in terms of the income effect in case of full FTA scenario, resulting in a 0,4% real income decrease. Such results are explained by the negative terms of trade effect for Ukraine. However, the income losses estimated would be even higher in case of simple FTA highlighting the positive effects of the "deep" form of agreement stemming from removal of NTBs. The EU was estimated to increase real income by 0,21% under "full" FTA versus 0,13-0,14% under "partial" versions of FTA. The "full" FTA is shown to, however, increase the GPD of Ukraine by 0,68% as well as to raise wages. The agricultural

and processed food sectors were shown to also tremendously grow in exports to the EU due to the "full" FTA.

Another illustration of applying CGE modeling in estimation of the effects of the Ukraine-EU FTA but with a focus on the agricultural sector has been conducted by Cramon-Taubadel et al. (2010). They applied the CGE model to depict its application to stylized scenarios for trade liberalization between the EU and Ukraine with a particular disaggregation for the agricultural sector and for important trading partners of Ukraine. After incorporating the changes from the WTO accession into the baseline model authors simulated two scenarios: one with uniform reduction of applied tariffs by half and other one additionally assuming increase of the technical efficiency of Ukraine's agricultural production by 5% over the simulation horizon of approximately 3-5 years. They find out that scenario with technical efficiency greatly increases the welfare gains for Ukraine. The technical change effects outweigh allocation and terms of trade benefits for Ukraine. In terms of increased agricultural production and exports they found trade diversion to take place. Overall, the authors highlight that non-tariff trade barriers, particularly quality and certification regulations for agricultural and food products from Ukraine may be the key stumbling block to reap the most benefits from the FTA with the EU. This reaffirms the relevance of accounting for technical improvement following "deep" integration that may create or increase trade in previously absent or limited trade flows.

Chauffour et al. (2010) assess the implications of the simple FTA between the EU and Ukraine with an even more detailed disaggregation for the agricultural sector. Using a CGE model they find that tariff-reducing trade liberalization would be beneficial, bringing 206,7 million USD on annual basis, despite inflicting some sizable costs to agricultural sectors like sunflower oil processing and meat processing.

Focusing on agriculture Nekhay et al. (2011) also conducted a quantitative assessment of the potential impacts of a FTA on agricultural commodity markets in the EU and Ukraine using the dynamic, partial equilibrium model AGLINK-COSIMO, which has been adapted and applied. They assessed effects of import tariffs elimination for 14 main agricultural commodities. Their simulation results indicate a positive change in producer revenue of 393 million Euros in Ukraine and of 860 million Euros in the EU. However, they find that the gains from the FTA are heterogeneously distributed and are of significantly varying magnitudes among commodities.

Movchan and Giucci (2011) contribute to the literature on quantification of the effects from the EU-Ukraine free trade agreement as well as from an alternative Customs Union with Russia, Belarus and Kazakhstan. They applied the CGE model from Copenhagen Economics et al. (2005) with more recent data for Ukraine in 2008. The results of simulations showed that the customs union would be welfare reducing for Ukraine by 0,5% in the medium and by 3,7% in the long-term. This welfare reduction is motivated by increased tariffs in Ukraine and trade diversion. The free trade with the EU, however, was

shown to generate welfare gains of 4,3% in the medium and stunning 11,8% in the long-term from the deep and comprehensive FTA. Overall exports of Ukraine were shown to increase by 2,8% and 6,3% in short and long run.

An extensive study focusing on the NTBs in trade between the CIS countries and the EU was conducted by Maliszewska et al. (2009). They estimated the effects of removing NTBs in trade between the EU and Russia, Ukraine, Georgia, Armenia and Azerbaijan. The modeled NTBs comprised legislative and regulatory requirements (standard costs), customs rules and procedures (border costs), and costs of access of foreign providers of services. The NTBs were based on the adapted data from the surveys by Jakubiak et al. (2006), Pavel et al. (2006) and BIZPRO (2005) for Ukraine. The CGE modeled simulations of the deep FTA with the EU resulted in welfare gain of 5,8% in the long run in Ukraine, which was the largest among modeled CIS countries. However, the study did not demonstrate the product specific changes in exports. The modeled evidence of the potential positive welfare implications of the free trade "plus" agreement may be even larger if one considers other potential benefits such as pointed out by Sadowski: broader improvements in the Ukrainian legal system, curbed corruption currently prevailing at large levels, improvement of business climate and access to new financing sources, technology and management methods (2012). While tighter competition with EU firms may serve as a stimulus for modernization of Ukrainian enterprises, for instance, in terms of improving energy efficiency, it may also drive out of business those producers, particularly small and medium-size, who can't bear the initial costs of adhering to higher standards. On the other hand, adapting more stringent European standards regarding animal welfare is likely to have positive, though non-easily quantifiable, effects when taking into account ethical considerations.

Therefore, having examined the previous literature focusing on the potential effects of Ukraine-EU free trade agreement options, it can be concluded that most of the research has analyzed the tariff liberalization inherent in the simple FTA and did so using the CGE models. However, only a few studies approximated the effects of deeper FTA accounted for the non-tariff barriers. The results in terms of welfare changes as well as export, output, income and employment changes all highlight the superiority of the "deep" FTA versus the "shallow integration". All but one study in general reveal the positive effects from an extended free trade agreement and show these effects to be much larger in the long run, highlighting the relevance of my research focus on the role of institutional change in enabling and facilitating trade. Furthermore, agricultural and food sectors have been identified to be among the key ones to benefit from the FTA agreement in terms of impact and most relevant when accounting for NTBs.

CHAPTER III - THEORETICAL CONSIDERATIONS

The potential of trade liberalization to provide substantial trade creation and an impetus for economic and socio-political development is well recognized and warrants global negotiations such under the auspices of the WTO, as well an increasing number of regional and bilateral trade agreements. In this Chapter I first discuss the Armington specification laying the foundation for numerical trade models and its inherent limitation in the presence of initially non-traded products. I further explore the non-tariff barriers behind these zero trade flows and how institutional harmonization, characteristic to extended free trade agreements addresses them. I additionally explore the available approaches to reflect such liberalization.

3.1 Armington model of trade differentiation

The work of Paul Armington (1969) has introduced product differentiation according to their geographical origin of production as another driving force behind international trade, in addition to Ricardian technological difference and Heckscher-Ohlin factor endowment models. This noted a departure from perfect substitutability in traditional trade theory, marking a significant advancement in modeling trade and establishing the Armington model the workhorse for explaining trade flows in vastly applied CGE frameworks.

Lloyd and Zhang (2006) elaborate that the Armington specification was incorporated into the one- and multiple-country CGE models to alleviate the unrealistic specialization in modeling trade liberalization, to allow for presence in bilateral trade statistics of both exports and imports of the same goods, which leaps forward from traditional trade models with homogeneous products. The Armington model is the one with neoclassical supply side and the Armington specification for the demand side. Lloyd and Zhang study the properties of the model and identify that it doesn't have the component of comparative advantage in producing products cheaper compared to other countries, "because the sets of products produced by any two countries are disjoint" (2006, p. XI). This can be explained by examining the demand side with the Armington assumption of geographical differentiation. It implies that goods produced in different foreign countries by corresponding industries are different among themselves and that the national consumer views the products of a particular industry from several foreign sources (X_F) as a group of substitutes, which she recons as a separate group from the domestically produced goods (X_D) in her consumption utility function. While any well-behaved utility function from consumer theory could be used to reflect the choice between different substitutable goods, the most commonly applied utility function is of a Constant Elasticity of Substitution (CES) functional form:

$$U = \left[\beta_F X_F^{-\rho} + \beta_D X_D^{-\rho}\right]^{\frac{-1}{\rho}} \quad (1)$$

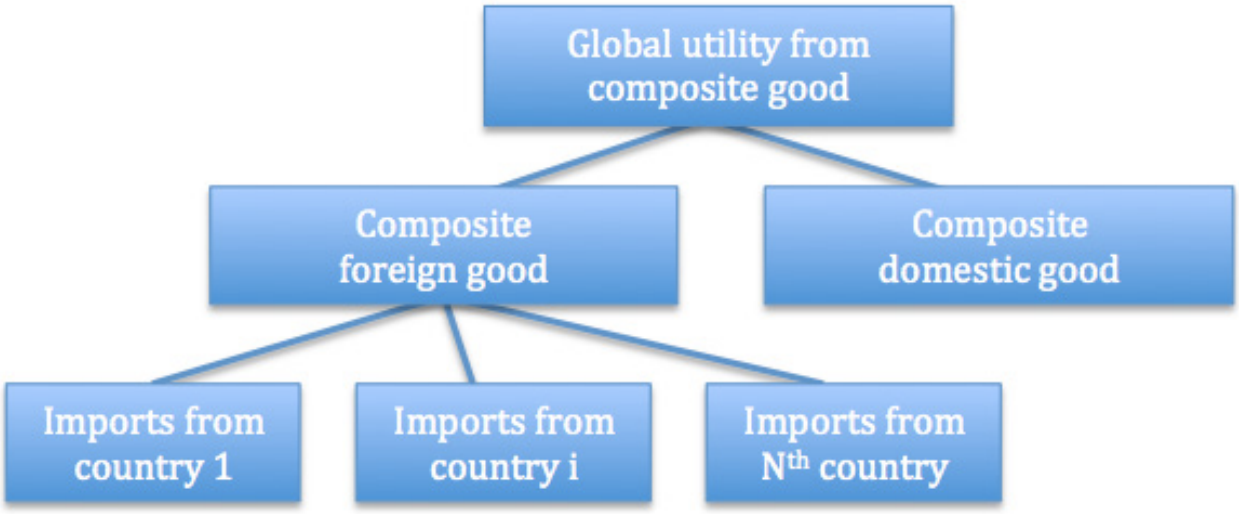
where, β_F and β_D are positive and sum up to 1, and $\rho \geq -1$.

The elasticity of substitution between domestic and foreign goods in this case is as indicated - constant, $\sigma = \frac{1}{\rho+1}$. The utility function is maximized subject to the budget constraint:

$$R = P_D X_D + P_F X_F \quad (2)$$

The number of products in the model is fixed, which, in turn, prevents considering increased product variety as a benefit of trade liberalization. The key feature is that the demand system employs a two-stage separable consumer preference structure of the type illustrated in Figure 2 with linearly homogeneous sub-functions in the second stage.

Figure 2 Armington model two-stage demand structure



Source: Own illustration based on Van Tongeren et al. (2007)

At the upper stage of the separable consumer preference structure the consumer optimizes global utility from consumption subject to disposable income. It does not yet incorporate Armington differentiation. The composite quantities of foreign and domestic goods depend on the levels of aggregated prices and the income level. This first stage is represented by a maximization problem from equations (1) and (2).

In the second stage representative consumer is satisfying the composite level of foreign goods by choosing among the differing imports from various geographical origins according to the Armington specification. This is an expenditure minimization problem subject to CES functions for the composite imports defined in the first-stage. The demand structure in some CGE models may be extended to a three-stage structure, where even the imports from the same foreign country are distinguished among competing national

producers. The choice of the CES form is not obligatory, yet warranted due to several advantages. Some CGE models may incorporate Leontief or Cobb-Douglas functions, still special cases of the CES, at some levels of the separable structure but most use CES at both levels due to limited data requirements – only one parameter of substitution elasticity is needed as well as data on trade flows. Despite this and analytical appeal, the CES involves the "small share" problem.

Van Tongeren et al. (2007) elaborate that this "small shares stay small" problem is associated with zero trade flows. In CGE models based on the Armington specification the parameters determining behavioral responses rely on previous years data reflecting the policy conditions at that time and extrapolate them into the future. However in doing so, these models do not predict significant trade flow changes for countries previously not exporting. The CGE models are prone to this problem "because producer and consumer 'incentive' prices are calculated as volume weighted shares of prices of domestic and imported goods"(Van Tongeren et al., 2007, p.3). Thus in case trade is close to zero in reference periods these trade-weighted averages will not capture fully the effects from trade liberalization and understate the trade creation effects. The problem of "small shares" is captured by the share parameter reflecting the relative importance of imports from particular country compared to total imports. As illustration Van Tongeren et al. (2007, p.4) show the input demand function from the cost minimization problem to the CES preferences and a budget constraint as used in CGE as

$$\frac{X_i}{X} = \alpha_i \left(\frac{P_i}{P}\right)^{-\sigma} \tag{3}$$

Here X_i represents the quantity of input *i.* demanded, X is the quantity of output supplied, $\alpha_i$is the share parameter and σ is the common and constant elasticity of substitution between inputs. In the import demand system this equation represents the demand function of composite imports from different foreign sources. Then Xstands for total imports and X_i defines import from a particular country *i.* With all prices normalized to one the share parameter becomes the ratio of imports from *i.* to the total imports. In CGE the share parameter is calibrated based on previous periods and remains unchanged for the simulation causing a problem if the initial share of imports was zero and thus would remain so regardless of liberalization. Solutions to this problem range from *ad hog* substituting zeros in trade flows by small numbers or aggregating regions, to structural ones such as switching to homogeneous products and thus net trade or adjusting the functional form. These, however, do not address the core of the problem and result in either computational difficulties, necessity to estimate multiple additional parameters or prevent focusing on bilateral trade of interest (Van Tongeren et al., 2007). Crucially, also the small shares are a problem not if they arise from non-economic factors, but when they stem from trade barriers, which I proceed to look into.

3.2 Theoretical approaches to model non-tariff trade liberalization

Non-tariff trade barriers refer to multiple hindrances other than tariffs that inhibit and distort trade. These can be in the form of policies, procedures and regulations. Koo and Kennedy (2005) discuss them within three types: those imposed with the goal of limiting imports and boosting exports (in a trade distorting way); those intended to address socio-economic and political issues, but occasionally affecting trade; and those not envisaged as tools for trade protection, yet inevitably trade distorting. In the scope of agriculture Koo and Kennedy (2005, p.112) name the following NTBs to prevail:

(1) quantitative restrictions and similar specific limitations (e.g., quotas, voluntary export restraints, and international cartels);
(2) non-tariff charges and related policies that affect imports (e.g., antidumping duties and countervailing duties);
(3) general government policies that restrict trade (e.g., government procurement policy, competition policies, and state trading);
(4) customs procedures and administrative practices (e.g., customs valuation procedures and customs clearance procedures);
(5) technical barriers (health and sanitary regulations and quality standards, safety, industrial standards and regulations, and packing and leveling regulations).

As highlighted in Section 2.1 TBT and SPS measures are particularly relevant for Ukrainian agricultural exports. For TBT and SPS measures the economic literature has made a clear distinction between the national or country-specific standards and shared standards such as regional and international in order to separate the effect of their harmonization on trade (WTO, 2012). While analyzing the TBT and SPS measures would ideally be done individually, since they affect trade in diverse ways, it is often challenging and literature mostly relies on their broader measures in relation to trade. The NTBs are harder to negotiate than tariffs, since they have been put in place not just to restrict trade, but with other possible considerations like health, environmental or product incompatibility issues. Presence of standards on a national level as such has been shown not to be trade decreasing (Swann et al., 1996). Surely, product safety regulations, for example, raise production costs, but on the other hand they strengthen competitive advantage by allowing meeting stricter requirements and sending a positive quality message.

TBT and SPS measures are conveyed in economic literature as possible fixed initial costs of entering a foreign market. These costs are brought up by the need to invest capital and human resources in order to meet higher foreign standards. However, once met they don't pose additional variable costs. The initial costs mean in a realistic setting with heterogeneous firms that less productive ones will close, while more productive ones will reap benefits from intensive margin of trade (due to expansion) and intensive margin of trade (due to accessing new markets). Since compatibility of standards is also important

for preventing oversupply of unsuitable varieties in addition to supply in the goods demanded by foreign markets, achieving it is trade enhancing. Whereas, the dissonance of TBT and SPS measures among countries, particularly involving trade from developing to developed countries, has been concluded to restrict trade based on the prevailing empirical evidence (WTO, 2012).For example, Gervais et al. (2011) show that varying standards have a negative effect on pork and beef trade, based on an index of regulatory differences in veterinary drugs and pesticides.

Dealing with the incompatibility of standards among countries can be done via mutual recognition or harmonization. Mutual recognition agreements have been said "to not likely be an option, however, if there is a significant difference in the initial standards of the countries, as became evident in the context of the European Union" (Chen and Mattoo, 2008). This, as argued by Chen and Mattoo, is due to the overarching exemption in the EC treaty, Article 36, reserving the right for countries to ban imports based on safety or health reasoning if used not in discriminatory way (2008). However, since some countries have more stringent standards, the effects of mutual recognition are diminished.

Harmonization of standards means that countries involved in a trade agreement adopt common policy objectives as well as technical means for attaining them instead of initially differing ones. Doing this is useful due to obtained economies of scale from entering mutual markets. Despite possible drawback such as trade diversion to other countries outside the regional trade agreements or decreasing the variety of products, harmonization is key to mitigating the role NTBs have in preventing or limiting trade. And this role is very large, even compared to tariffs, as shown by a prominent paper by Kee et al. (2009). This study estimates the ad-valorem tariff equivalents (AVE) for 91 countries for a 4575 six-digit product lines from Harmonized System of product classification containing "core" NTBs or measures of agricultural support applied by at least one country. The used "core" NTBs include price control measures, quality restrictions, monopolistic measures and technical regulations. Kee at al. find the presence of AVE of core NTBs in about half of product lines and being higher than tariffs (2009). About a third of product lines bears agricultural support, AVE of which is also larger than tariffs. Over the whole range of products based on their overall trade restrictiveness index, NTBs and agricultural support are on average across countries nearly twice the level of trade restrictiveness of tariffs. Therefore, harmonization of standards as a way of non-tariff trade liberalization is important due to its potential to enable trade in the presence of strong prohibitive NTBs. It does this among other way by lowering the information costs regarding the procedures and regulations for the members of a trade agreement thus decreasing the costs of adhering.

Economic literature addresses the NTBs through several approached. Apart from studies covering specific NTBs and special purpose methods[2], there are three main approaches to estimate non-tariff impediments to trade. These approaches cover price-comparison, frequency-type and quantity-impact measures.

The first approach is based on the price-comparison measures. Estimates of NTBs can be obtained due to their effects on prices resulting in differences between domestic and foreign prices. These methods examine the effects of all NTBs as one cannot easily determine which particular measures affect the prices in various cases. Thus, following this approach it is possible to calculate percentage differences between the prices comparable to tariffs. The second group of frequency-type measures is based on using data for NTBs, for example, from the UNCTAD database or special surveys of firms' costs. Based on such data frequency or import coverage ratios are calculated. These are further transformed into ad valorem equivalents of NTBs. The third approach relies on quantity-impact measures. The potential trade without NTBs and the actual trade are compared following these methods. Typically, Heckscher-Ohlin, Helpman-Krugman or gravity models lay the foundation of the econometric estimations. NTBs are measured by using either residuals of estimated regressions or different dummy variables.

The first approach, which consists of price comparison measures, was applied by Andriamananjara et al. (2004). They estimated the price-wedges for NTBs in several sectors and analyzed the global impact of their reduction. Because the NTBs are trade limiting, they create scarcity and abnormally high prices. Thus the level of restrictiveness of NTBs can be measured as price difference between imported goods and domestic substitutes, or alternatively between domestic and the world prices. Authors used price data from Euromonitor and NTB coverage from UNCTAD to compute global AVE, which they later incorporated into the CGE model on top of the regular tariffs. They further confirm the significance of the NTBs by estimating the global gains of their removal to amount to 90 billion USD. However, as indicated by WTO (2012) the logic behind this price-gap approach measuring the NTBs as the price difference is prone to problems. There is an array of factors that affect prices and costs throughout the supply chain, which are unrelated to NTBs. One needs to exclude these incorporated costs present, for example, in varying INCOTERMS prices like "free-on-board" (f.o.b.) or "cost-insurance-freight" (c.i.f.), or internal transport costs and distribution margins accounted in wholesale and retail prices.

The second approach of frequency-type measures was employed, for example, in the above-mentioned study by Kee et al. (2009), who calculated tariff equivalents for three measures of trade protection – trade restrictiveness indices. Their core NTB data was

[2]These special purpose methods cover elasticity estimation, determinants of variations in elasticity estimates, variations in effects of NTBs over time, binding of NTBs, risk characteristics of NTBs according to Maliszewska et al. (2009).

obtained from UNCTAD's TRAINS database, which, however, highly lacks up-to-date information for CIS countries including Ukraine. They calculated the ad-valorem equivalents of core NTBs and percentage agricultural domestic support as well as three trade restrictiveness indices. Their data on one of the indices computed for Ukraine – market access overall trade restrictiveness index capturing trade barriers imposed by other countries on exports from particular country – was 6,9%. The overall trade restrictiveness index for the EU – summarizing the effect of its own trade policy on its imports – was 8,6%. The simple frequency ratio of "core" NTBs for Ukraine was at 17%, but for the most recent year available – 1997.Movchan and Shportyuk (2010) followed the approach of Kee et al. (2009) in estimating the tariff equivalents of NTBs, but did it for the sectors they estimated to be most NTBs-intense in Ukraine. They analyzed the impact of liberalization of core non-tariff measures applied by Ukraine to other countries on Ukraine's welfare through computable general equilibrium model of the economy. Movchan and Shportyuk (2010) initially derived information on presence of at least one core NTB from Ukraine's legislation at 10-digit HS level placing the value of 1 in case of any NTBs present and zero otherwise. The sectors in Ukraine with high levels of core NTMs on imports were food processing, petroleum refineries, chemical, rubber and plastics, machinery and equipment. By estimating ad-valorem equivalents for the core NTMs in those sectors using the gravity model and then plugging the results into the CGE model Movchan and Shportyuk (2010, p.4) found that "a reduction of a protection level by half – results in welfare gains measured as Hicksian equivalent variation ranging from 0,4% to 2,8% of Ukrainian consumption over medium-term horizon depending on the scenario specification". The different scenario specifications refer to the three ways of inserting in the ad-valorem NTB equivalents into the CGE model: as additional import duties, as waste border costs or as tax on imports.

The third approach of quantity-based measures based on gravity model was pursued by various authors dealing with border effects in the EU enlargement (Brenton and Vancauteren, 2001; Chen, 2004). The border effect implies the magnitude by which internal trade is larger than international trade when one accounts for the economic causes of it. Brenton and Vancauteren (2001) used a gravity model applied to sectors divided according to the EU's approach for non-tariff liberalization, namely New or Old Approach, or mutual recognition, to find the effect of technical barriers on EU's imports. The obtained border effects, proxied by dummy variables, were shown to be significant for the sectors covered by the harmonization approaches. Chen (2004) emphasized, however, that border effects are smaller if relative prices are controlled for and depend on the way distances are measured in the gravity equations.

Another study by Chevassus-Lozza et al. (2005) aimed to assess the role of NTBs for eight new member states' exports of agri-food products prior to their EU accession, for years 1999 and 2003. The authors apply a detailed sectoral gravity model, which includes

several categories of NTBs as dummy variables: sanitary and phyto-sanitary measures (SPS), quality measures and import certificates. They use the NTBs data from the French Customs source covering EU border regulations. The results show that in 1999 NTBs posed serious impediments to trade but the decreasing size of their coefficients indicates the diminishing role of NTBs over time due to progress in implementation of the *acquis communautaire* most of all for the SPS and quality measures.

Frahan and Vancauteren (2006) use a gravity model for measuring the trade impact of harmonizing food regulations among several old EU member states. Their model incorporates a measure of harmonization of technical regulation, for which they used the data from the work by Brenton et al. (2002). The authors confirm that the theoretically based functional form of the gravity equation coming from the Anderson and Wincoop (2003) allows estimating tariff equivalents of trade costs of non-harmonized EU food regulations. They show that harmonized EU food regulations prompt larger trade within the EU at the aggregate sector as well as on sub-sector levels, which have varying but largely positive effects.

Philippidis and Sanjuán (2007) in their study of the effects of regional trade agreement between Mercosur countries and the EU applied the gravity model to calculate tariff-equivalent estimates of NTBs and implement them into a computable general equilibrium (CGE) model. This paper favors the residual-based method when discrepancies between actual and predicted trade signify the trade barriers. Their gravity equation is used to predict potential trade. Philippidis and Sanjuán (2007)argue in favor of residual-based method because unlike the dummy-based method it provides a combined estimate of all potential NTB trade costs as opposed to the trade cost component related to the dummy in question. It also allows estimation of NTBs in both trade directions of each trading pair, unlike the merely "average" cost estimates from the dummy specification.

Lejour et al. (2001) in their estimation of the effects of NMSs joining the Single Market used the gravity specification including apart from trade flows, distance and tariff variables also the dummy for the EU membership. The coefficients of this dummy were significant and positive in 10 of the 16 industries suggesting the increase in trade between EU member countries. These coefficients for various sectors were used to show the potential trade increase in these sectors from EU accession. To obtain the measures for the NTBs they translated the potential trade increase into Samuelsonian iceberg-trade cost of the barriers – NTBs. The potential trade increase per sector was also multiplied by existing trade shares to obtain the aggregate trade increase per country. The results were substantial and positive for the CEEC, Poland and Hungary, whose exports grew overall by 32%, 30% and 44%, while bilateral exports with the EU even more, by 52%, 50% and 65%. The growth in aggregate and bilateral exports for the EU was of a lower magnitude of 2% and 51%.Philippidis and Carrington (2005) follow the gravity technique and use the same CGE aggregation as Lejour et al. (2001) but in their gravity model they incorporate

the spatial effects. Their findings suggest overestimation of NTBs for eleven out of sixteen sectors when employing traditional econometric techniques as by Lejour et al. (2001).

Overall, the theoretical considerations on trade liberalization reveal the pitfalls of applying standard CGE simulations based on the Armington model with product differentiation by geographical origin on the demand side presented by a CES functional form. The trade effects from these models are underestimated if trade flows have been negligible or zero prior to liberalization. This is largely the case due to non-tariff barriers to trade, especially TBS and SPS measures in agriculture, which show to have larger trade inhibiting effects than tariffs. Despite being warranted in general, these measures, if not harmonized, are found to be trade restricting. Institutional harmonization in regional trade agreements addresses such disparities prompting positive trade effects. While several approaches have been applied to assess effects of harmonization and account for NTBs, their limitations must be considered in Ukrainian context when focusing on particular under-traded commodities. Data scarcity or outdated information regarding core NTBs is one of such stumbling blocks. Furthermore, the need to account for effects from complex institutional harmonization to the EU's *acquis* in multiple spheres requires a broader measure of analysis than covering specific NTBs.

CHAPTER IV – DATA

In this Chapter I approach the research questions by first identifying the product categories facing zero or small exports from Ukraine to the EU. Secondly, the choice of data is motivated given the approach of RD, which is detailed in the next Chapter. The available data is used initially to graphically demonstrate the effects for the NMSs as well as to argue in favor of the validity of the required assumptions for the RD approach.

4.1 Zero and small trade flows between the EU and Ukraine

To determine the under-traded agricultural and food products I got the key required data from the Comext database containing detailed publicly available trade statistics for the European Union and its partners (Eurostat, no date). Examining the two-digit Harmonized System product classification of Ukrainian agricultural and food commodity exports to the EU over the available period from 1999 to 2012 reveals that 40% of the product groups bear zero or small (less than 1000 Euros) trade values in at least half of years. The products that have zero trade flows in all periods make up 10,5% of all four-digit product lines of the 24 two-digit categories for food and agricultural products. The number of non-traded product lines was much higher in the post-2008 periods, which could be due to the costs of conforming to the WTO regulations or the effects of the economic crisis.

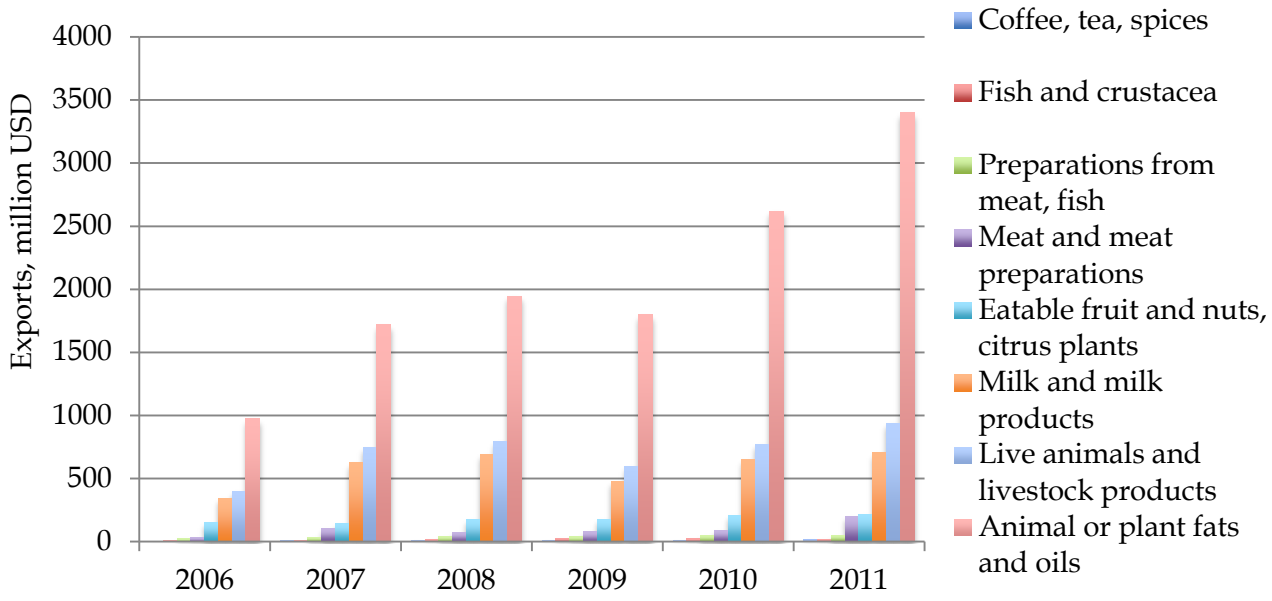
Table 2 Product categories with zero or small exports from Ukraine to the EU in 1999-2012

Product group	Share of product lines,(number)
Dairy produce; birds' eggs; natural honey; edible products of animal origin not elsewhere specified or included	75% (9)
Meat and edible meat offal	54% (6)
Live animals	50% (4)
Animal or vegetable fats and oils and their cleavage products;	50% (12)
Products of animal origin, not elsewhere specified	46% (6)
Fish and crustaceans, molluscs and other aquatic invertebrates	45% (5)
Edible fruit and nuts; peel of citrus fruits or melons	43% (7)
Coffee, tea, mat and spices	38% (5)

Note: the EU includes consecutive enlargements. Source: Own calculations based on Comext

The products with the biggest share of zero or small trade flows are listed in the Table 2. Dairy and various animal products have the biggest proportion of trade lines with zero or small trade flows with the EU throughout the last 14 years. This is not surprising given the regulatory system including standardization and certification mechanisms inherited from the USSR and fully updated to the international standards. The standards employed (GOST and DSTU[3]) are numerous, outdated and overly prescriptive. Various authorities in charge of various aspects of food regulation such as the State Committee of Ukraine for Technical Regulations and Consumer Policy (DSSU), the State Sanitary and Epidemiological Service (SES) under the Ministry of Health Care, the State Committee of Veterinary Medicine, and the Ministry of Agrarian Policy often overlap in their competencies and result in redundant inspections instead of an comprehensive risk based control system of the production process, such as HACCP. The testing laboratories based on GOST/DSTU do not meet the requirements of the European Union and other industrial countries. For example, approximately only 1,5% of all laboratories in Ukraine were reported by the IFC to be accredited under ISO 17025 (World Bank, 2009). This limits the export markets for these products and resulted in their exports mostly to other CIS countries. However, looking at the export data for similar products classification based on HS from the Ukrainian State Statistical Service we can see that several of the product groups not exported to the EU have been largely and increasingly exported by Ukraine in general from 2006 to 2011, as shown in Figure 3.

Figure 3 Ukrainian total export dynamics of selected products



Source: Own calculations based on the State Statistical Services of Ukraine (Ukrstat, 2014)

[3]GOST (Gosudarstvennyi Standard – State Standard) is a standard used in the former Soviet Union and still in the countries of the Commonwealth of Independent States (CIS). DSTU (Derzhavniy Standart Ukrainy – State Standard of Ukraine) is the official standard used in Ukraine since independence.

Despite small or zero exports to the EU product categories such animal or plant fats and oils, live animals and livestock products, as well as milk and dairy goods have been extensively exported in general, which highlights their potential for export to the EU in case of meeting appropriate standards and regulations as it is the case among CIS countries, which inherited same Soviet standards. Emerson et al. in a thorough overview of the deep EU trade integration perspectives for Ukraine further highlight that the competitiveness of Ukrainian agricultural sector is restrained by absence of capabilities to meet EU's SPS measures, resulting in that "Ukraine is currently not able to export virtually any animal products or processed foods to the EU" (2006, p.118). Other product groups such as coffee, tea and spices, fish and crustacea, fruit, nuts and citrus plants depict very small overall in Figure 3 export quantities as they are not produced in Ukraine in large quantities due to natural and climatic conditions.

The focus of the research is, therefore, on the meat and dairy export potential for Ukraine to the EU as the result of institutional harmonization from the EU-Ukraine DCFTA. For the econometric estimation pursued later, detailed panel trade data for the European Union has been extracted from the Comext database. However, the previous studies show that GTAP model has been largely employed in estimating the effects of potential FTA agreement. Thus, for a better future inference of the results, I aggregated the exports data for the selected the top five categories of small and zero trade commodities into 5 GTAP sectors based on appropriate concordances between the GTAP database and the 6-digit Harmonized System. The final product groups are:

1. Bovine cattle, sheep and goats, horses (further on bovine animals): mostly live cows, horses, sheep, goats;

2. Bovine meat products (further on bovine meat): carcasses and edible offal of cows, sheep, goats, horses, asses, mules and their preparations;

3. Raw milk and dairy products (further on raw milk and dairy): milk and milk protein concentrate, cheese, cream, yogurt, whey, butter, etc.;

4. Meat products not elsewhere classified (further on meat products): various preparations including chilled or frozen meat of swine and poultry and other non-bovine animals;

5. Animal products not elsewhere classified (further on animal products): live swine, poultry and other small animals, animal by-products such as hides, skins, fur skins etc.

Appendix I illustrates the absolute export values of these 5 product groups for the NMSs and Ukraine. We can see that, indeed, the values of exports have been small but began increasing since as early as 2001 for bovine meat and animal products categories. Bovine meat and meat products have been largely exported even before EU accession by

only Hungary and Poland. Ukraine depicted by the top line clearly has had nearly negligible export values of the covered products. The only category where it had comparable exports is raw milk and dairy and specifically from 1999 to 2002. However, these exports consisted nearly completely of a single product - casein - milk protein concentrate.

4.2 Descriptive evidence of the treatment effect for the NMSs

In order to estimate the impacts of the institutional change coming from the "deep" components of the DCFTA and the Association Agreement I revert to the experience of 8 NMSs that joined the EU in 2004, namely Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovenia and Slovakia. Similar to Ukraine they also bordered the former EU-15 as well as faced similar influence of the Soviet Union in terms of being a former Soviet republic as the Baltic States or the USSR aligned countries of the Eastern Bloc. While their policy legacy has not been identical, when joining the EU they passed through a bilateral process of negotiations and followed the same procedures as well as criteria to ensure harmonization of their policies with the EU.

The nature of the Association agreement and its DCFTA component between the EU and Ukraine implies alignment of Ukraine's legislature to the EU's a*cquis communautaire* in multiple spheres. The gradual approximation to the norms and standards of the EU only in trade and trade-related areas implied by the DCFTA already covers "standards and conformity assessment rules, sanitary and phyto-sanitary rules, intellectual property rights, trade facilitation, public procurement, and competition, strong binding provisions on trade-related energy aspects, including on investment, transit and transport" (EC, n.d. (b)).The text of the Association Agreement, in particular Article 56 paragraph 1 states "Ukraine shall take the necessary measures in order to gradually achieve conformity with EU technical regulations and EU standardization, metrology, accreditation, conformity assessment procedures and the market surveillance system, and undertakes to follow the principles and practices laid down in relevant EU Decisions and Regulations"(EU, 2012a). To achieve this the Association Agreement, Article 56, 2 further specifies that "Ukraine shall, in line with the timetable in Annex III to this Agreement: (i) incorporate the relevant EU *acquis* into its legislation" (EU, 2012a). This timetable is to be determined by the Parties. Specifically for the SPS measures the process of harmonizing Ukraine legislature to that of the EU will be done based on a comprehensive strategy for the implementation of the Chapter on SPS measures, which is to be submitted by Ukraine three months after signing the Association Agreement at the latest (EU, 2012a).Despite the fact that signing the agreement does not imply EU accession it is positioned as a milestone towards it. In the analysis of the nature of the DCFTA and its implications for Georgia, Messerlin et al. (2011) conclude that signatories of the DCFTA with the EU "could be described as if they were an EU MS, but one without full market access, without full EU aid and without

voting right in the EU decision-making process" (2011, p.24). We may thus expect the effects of the EU NMSs' accession to be the most suitable of the available approximations for the effects for Ukraine, although constituting their upper bound.

The NMSs could join the EU after having demonstrated compliance with the EU standards and rules. The candidate countries were subject to the assessment by the European Commission based on a number of conditions - Copenhagen criteria - that are to be met prior to opening the negotiations regarding the accession process. These Copenhagen criteria cover political and economic issues, as well as aspects such as the ability to adopt and oblige to the laws and policies of the EU and being able to create the conditions for integration through institutional change by adapting administrative structures to the EU's. The Council had to take the decision following the Commission's opinion regarding granting the status of the applicant country. Once this status has been granted, the negotiation process began. It covered conditions and schedule of the adoption, implementation and enforcement of all EU rules, which make up 31 different policy chapters, based on the *acquis*, among which - agriculture. Applicant states essentially agree on means and timing of adopting these rules during the implementation period as well as are obliged to present guarantees of the timeliness and effectiveness of such implementation. These negotiations start with a preparatory stage or screening done by the Commission to evaluate the level of preparation of the applicant countries and to identify the chapters requiring alignment. The negotiations are held bilaterally among the governments of the applicant country and existing Member States. Once the benchmarks defined for each chapter are reached such as legislative measures, administrative or judicial instances, aspects of the *acquis* actually implemented, a viable market economy for the economic chapters, the respective chapter is closed with possibility of being reopened in case the country does not satisfy the conditions (EU, 2007).

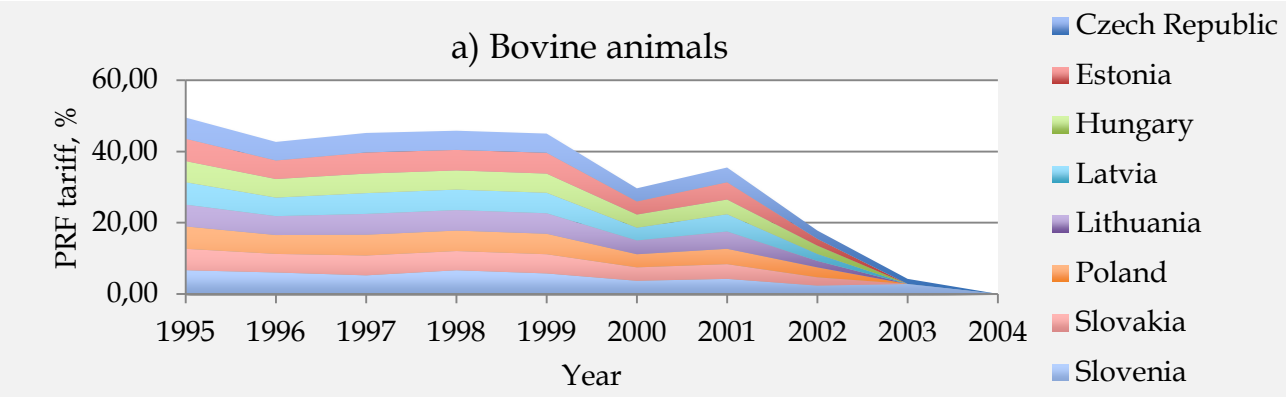
The countries considered here applied for the EU membership in 1994 (Hungary, Poland), 1995 (Slovakia, Latvia, Estonia, Lithuania), 1996 (Czech Republic, Slovenia) (EC, n.d.(b)). The accession negotiations, however, started on March 31, 1998 with Hungary, Poland, Estonia, Czech Republic and Slovenia and on October 13, 1999 with Slovakia, Latvia and Lithuania. They were concluded in December 2002 for all 8 countries covered here. Having completed these negotiations the countries signed the Accession Treaty in Athens on April 16, 2003 (EC, n.d.(c)). From then until the accession on May 1, 2004 this treaty was subject to ratification by all current and future Member States. The applicant country continued to implement changes implied by the accession in the areas still requiring adjustment under monitoring of the Commission. In our context thus the period from 2002 until the accession in 2004 is of direct relevance as during this time the conditions of adjustment were defined and commenced being implemented. The average of this period - year 2003 is a valid threshold in the process of institutional change

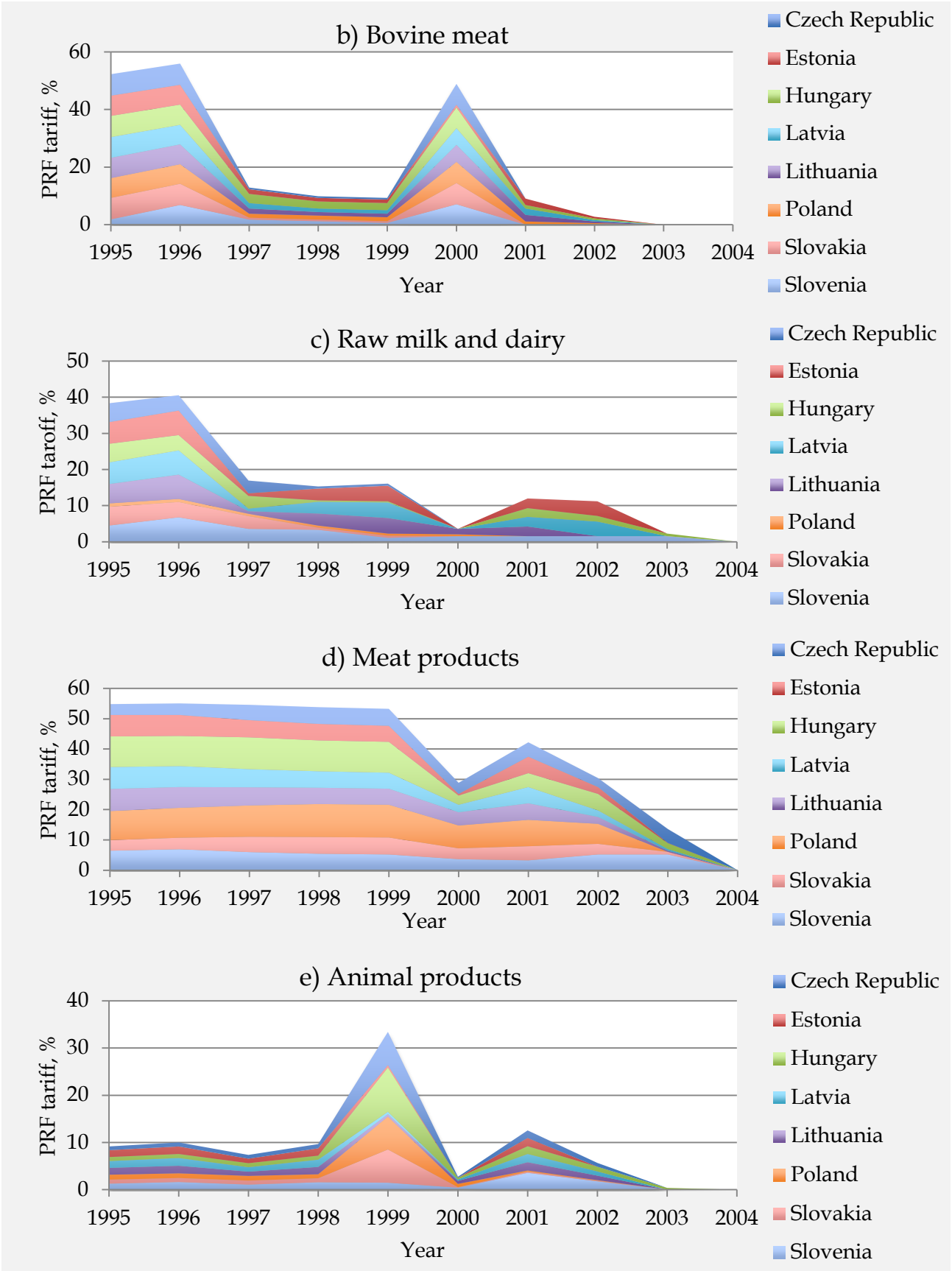
stemming from the EU accession as it marks the date for finalized Accession Treaty with detailed provisions regarding legal adherence to the EU's *acquis communautaire*.

Agriculture has been the most substantial of the negotiated chapters of the *acquis*. It covered mostly legal provisions that were to be applied directly at the date of joining the EU. Veterinary and phyto-sanitary fields are of particular interest for us in the context of exporting previously unpermitted goods. Regulations in these fields are mostly made up of directives. Several transitional periods were negotiated in the veterinary and phyto-sanitary sector to ensure safety of public, animal or plant health in the EU.

Having touched on the nature of the processes faced by the NMSs and the envisaged one for Ukraine, I may proceed to check my second hypothesis of whether the discussed harmonization in NTBs resulted in a growth of exports. Prior to that let's examine the situation regarding tariff reduction that preceded the institutional changes. The tariff data was obtained from the World Integrated Trade Solutions (WITS) portal that extracts the tariff data from various initial sources, TRAINS in my case, and offers choice between several methods of calculated ad-valorem equivalents – WTO agriculture method here (WITS, no date). Since the data on tariffs was required of a panel type, few observations have been missing and had to be forecasted. The predicted values for these tariff observations were obtained based on the dependent variable (year) for the specific missing observation and the independent variable (available tariff observations) by using a least squares linear regression. The Figure 4 illustrates the simple average preferential (PRF) tariffs applied by the EU-15 to the NMSs for the five product categories considered. The graphs demonstrate that despite the tariffs have not been fully removed prior to joining the EU in 2004 they have been substantially decreased by as early as 2002 for some products like bovine meat and milk and dairy goods. Most of the depicted categories illustrate that already since 2001 the tariffs have been leveling off to be lifted in 2004. Since the full removal of tariffs took place in 2003 and 2004 depending on the category it is needed to account for the tariff aspect in my model to ensure that the estimates from the analysis focusing on the aspect of institutional harmonization will not account partially for the tariff removal and thus overestimate the effects from the institutional harmonization.

Figure 4 EU-15 import tariffs for the NMSs





Source: Own illustration based on World Integrated Trade Solutions (WITS, no date)

I can therefore examine the panel data for annual value of exports of selected 5 product groups for the 8 countries for the period from 1995 to 2011. The export values data has been deflated using the World Bank Consumer Price Index to get the real values of exports in Euros from the NMSs to the EU-15 (WB, 2014c). The following graphical representation of the data allows to first-hand observe the effects on exports occurring around the accession period for the NMSs. The average export data for the eight countries is graphed versus the assignment variable of a year, which is used as a proxy for the institutional change occurring at the specified threshold based on the finalized legal provisions of alignment.

The assignment variable is grouped into bins making sure that there is the same number of bins on both sides of the threshold in order to separate the treated and the non-treated observations. According to the Imbens and Wooldridge (2009), given the chosen bandiwidth of h=1, I have K_0 and K_1 bins to the left and right of the threshold c.

I construct bins $(b_k, b_{k+1}]$, for k= 1, … , K = K_0 + K_1 , where

$$b_k = c - (K_0 - k + 1)\, h \tag{4}$$

And the average value of the outcome variable in the bin is

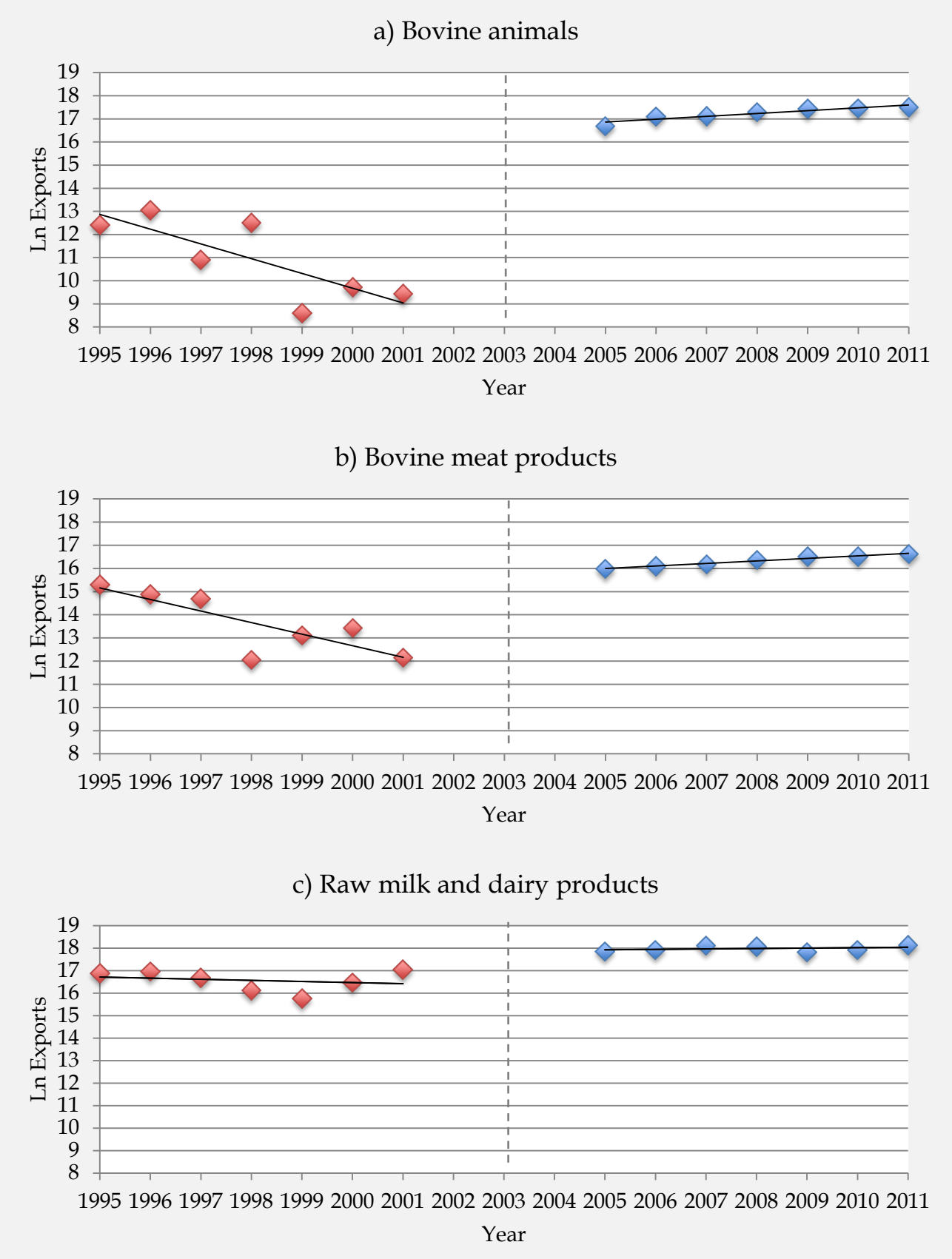
$$\bar{Y}_k = \frac{1}{N_k} \sum_{i=1}^{N} Y_i \, 1\{b_k < X_i \leq b_{k+1}\} \tag{5}$$

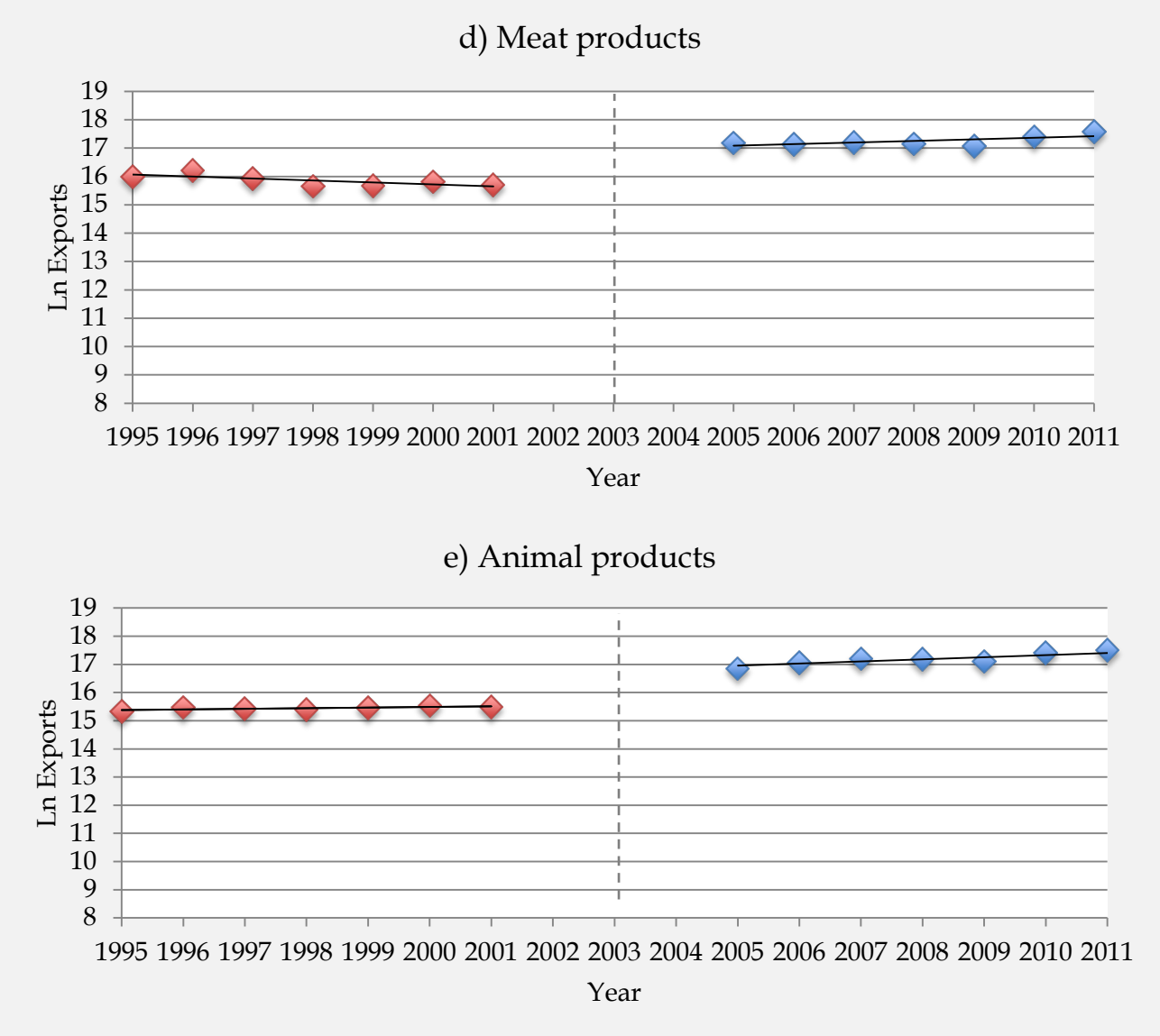
where N_k is the number of observations in each bin, eight in our case. This already ensures no manipulation by having discontinuous assignment variable at the threshold, which will be graphically confirmed later on.In our case of a relatively short overall time span the middle of bins against which the outcome variable is to be mapped is represented by the year itself. The effect of interest is reflected in the discontinuity around the defined time threshold.

The Figure 5 shows the biggest jump in exports to accrue for the first category of bovine animals. The discontinuity is of approximate magnitude of 8 logarithm points. Bovine meat products also exhibit a very large discontinuity of about 4 points. Raw milk and dairy products depict a similar jump with meat products and animal products categories of approximately 1 logarithm point.

Presenting the data raw data this way allows also for a fair first-hand approximation of the suitable functional form for the before and after the threshold data. We can see that for most product groups the linear functional form applied does a good job of reflecting the trends in the exports.

Figure 5 The treatment effect for selected products for NMSs





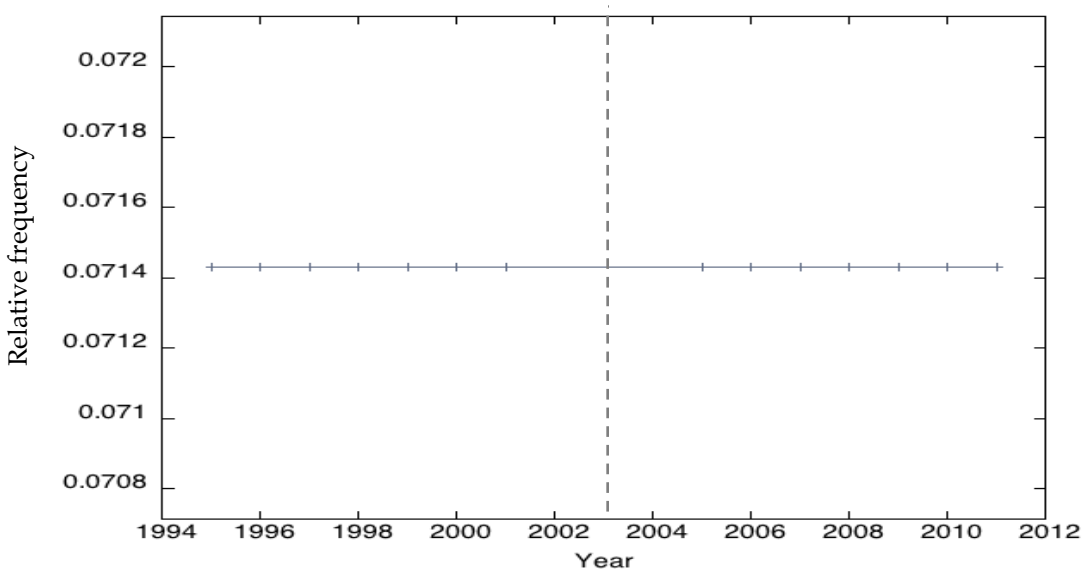
Source: Own illustration based on Comext

An important check to be made is whether there could be observed discontinuities in other places than the threshold. Such discontinuities would undermine the inference for the causal effect of the institutional change if they would happen also in other time periods. However, there seem to be no significant disturbances in the trends both prior and after the institutional change. The data for bovine animals and meat is more dispersed. It looks as after 1998 the exports picked up versus previous declining tendency. This seems reasonable as by this time the countries had to comply to the EU criteria including the economic ones which may have allowed for more favorable general economic situation or already facilitated export conditions by the fact of commencing accession negotiations that year.

In application of the RD design there are two main concerns regarding its validity. The first concern is about potential manipulation of the assignment variable to self-select

into treatment by the individuals. The second one is that there may be other major changes than treatment occurring at the threshold, which could affect the outcome of interest. Since they may influence the outcome these effects may erroneously be attributed to the treatment effect and overestimate it. The first concern regarding the assignment variable is quite obviously impossible due to the fact that the variable is the calendar year and cannot be manipulated. Formally, it can be intuitively tested by examining the aggregate distribution of the assignment variable for discontinuity, which could be due to clustering just after the threshold.

Figure 6 Continuity of the assignment variable



Source: Own illustration

In Figure 6, in line with the first step in McCrary (2008) I have computed frequencies of observations for the assignment variable grouped into evenly spaced bins. As presumed by the data and the choice of the assignment variable there is no evidence of prevailing observations after the year 2003, which could bias the results of the RD design in our case.

Regarding the second concern for the RDD, it is informative to look at the panel data for covariates collected from the FAO statistical database, namely the data on agricultural population, meat and milk production as well as the data on the share of agricultural area in total area, which is from the World Bank database (FAOSTAT, 2014; WB, 2014d). The average values for the period prior and after the institutional change are presented on average for the eight NMSs in Table 3. The values of the variables are of similar magnitude before and after the threshold thus favoring the assumption of no other significant events occurring at that time, which could affect these covariates representative of the agricultural sector, which could, in turn, cause the discontinuity in exports of meat and dairy products. The Table 3 additionally shows the average covariates for the sub-samples of countries and Ukraine, which is informative in the context of heterogeneity analysis

pursued later in Section 6.3. Exploring the differences between the NMSs and in relation to Ukraine, we can see that there are significant differences between the Baltic States and Slovakia and Slovenia on one hand and Czech Republic, Poland and Hungary on the other. Ukraine, a larger country as well as the group of Eastern European States appears to thus have agricultural characteristics more similar to those countries and even exceeding their average values as a bigger country. Individually it is closest to Hungary in terms of share of agricultural land and to Poland in terms of agricultural population, milk and meat production. However, Poland has outrun Ukraine in milk production since 2008 and has always been larger in meat production.

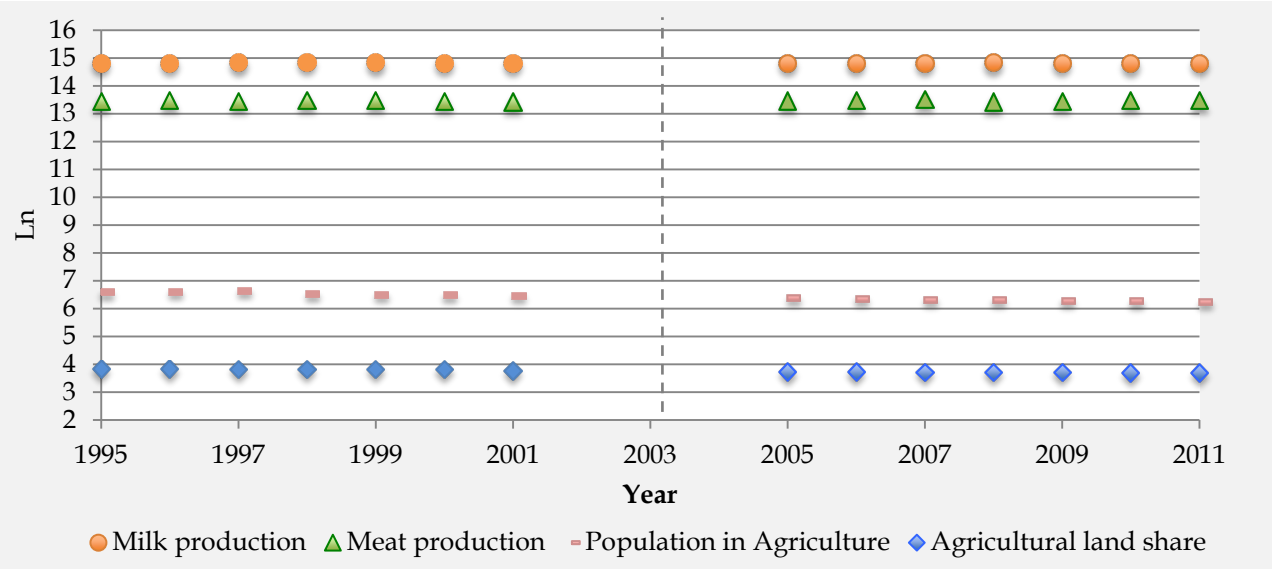
Table 3 Descriptive statistics of covariates for the NMSs

Baseline Covariates	1995 - 2001	2005 - 2011
Population in agriculture (8 NMSs), thousand, of which:	694,66	547,86
- Baltic countries, Slovenia and Slovakia	146,23	102,91
- Czech Republic, Hungary, Poland	1608,71	1289,43
Ukraine	3479,25	2600,29
Share of agricultural land (8 NMSs), percentage points	45,47	41,07
- Baltic countries, Slovenia and Slovakia	36,02	31,82
- Czech Republic, Hungary, Poland	61,22	56,49
Ukraine	71,85	71,26
Meat production (8 NMSs), thousand tones NMSs	699,10	712,83
- Baltic countries, Slovenia and Slovakia	125,05	127,58
- Czech Republic, Hungary, Poland	1611,71	1661,73
Ukraine	1837,73	1893,97
Milk production (8 NMSs), thousand tones	2770,93	2734,08
- Baltic countries, Slovenia and Slovakia	1035,65	1009,50
- Czech Republic, Hungary, Poland	5663,07	5608,38
Ukraine	14294,89	12138,47

Source: Own calculations based on FAOSTAT and World Bank

The supplementary graphical representation in Figure 7 of the baseline covariates versus the assignment variable in a similar manner to previous illustrations for exports also does not reveal any discontinuity around the threshold. This continuity assumption is additionally checked for statistically in upcoming Section 5.2 of this thesis. However, the choice of appropriate baseline covariates - those that are preferably determined prior to the realization of the assignment variable -is obviously quite difficult due to the assignment variable of time used, but also due to insufficient panel data for other relevant variables representative for the agricultural sector such as for example farm size, prices for the product categories considered or capital in agriculture.

Figure 7 Continuity of baseline covariates for full sample of countries



Source: Own illustration based on FAOSTAT and World Bank

Overall, I have identified that Ukraine's food and agriculture exports to the EU have been the least for meat and dairy products, while these goods were increasingly being exported by Ukraine in general. We further have seen graphically that these commodities have gained a significant increase of exports around the time of institutional harmonization for the NMSs. The discontinuity in exports has been the most profound for bovine animals and bovine meat categories. Importantly, due to the choice of the assignment variable we are sure to not have the issue of pre-selection into treatment – harmonization of the NTBs. However, the question appears whether any other unobserved events occurring during the threshold period account for the growth in exports. I have strived to negate this by demonstrating in accordance with the current literature regarding RDD that there is no discontinuity in the baseline covariates, which could have brought up these other changes. This is further supported by the fact that the trends in outcome variable prior and after to the cutoff do not exhibit discontinuities.

CHAPTER V – MODEL

Having explored the nature of non-tariff liberalization and a variety of approaches to reflect it in regional trade agreements I proceed in this Chapter to argue for my choice of method to correspond to the posed research questions. I, thereafter, explore the chosen econometric design, its theoretical framework and empirical specification in our case.

5.1 Method selection

Assessing the effects of the EU-Ukraine DCFTA with regard to the "small share problem" in widely employed CGE framework requires empirical estimation of the new baseline traded quantities after the institutional harmonization taking place, similarly to what has been done by Van Torgenen et al. to remedy this issue (2007). Specifically, the authors econometrically predicted trade flows in relation to trade barriers posed by tariffs while accounting for non-economic factors that affect trade. They then used these estimates to shift the CES Armington import aggregation functions to reflect possible changes in import composition in a CGE. The results demonstrated qualitative differences in the simulations based on the econometric model inputs compared to standard simulations. The findings based on the estimated trade showed redirection of trade and an increase in exports of previously less-exporting countries, while the standard model as expected showed the increase in market shares for those regions with already large market share. The possibility of correcting the CGE results based on econometric findings was also highlighted by Hertel et al. (2007), who argued that this offers substantial possibilities for improving the robustness of results. In their study assessing the FTA of the Americas via the CGE model this is achieved by incorporating econometrically estimated elasticities of input substitution for different countries. Ferrantino further provides arguments in favor of pursuing the quantity-based approach to account for NTBs, which provoke the initial zero trade causing the "small shares" problem (2012). Firstly, the approach to predict the new trade flows econometrically is useful due to availability of data on trade flows at high levels of disaggregation and available for Ukraine and the NMSs. It is also more suitable than the price-based method since prices are not observed when the NTBs are completely trade restricting or if the product is highly differentiated.

Therefore, I will focus on using the quantity-based approach of predicting the "new" trade flows for Ukraine as if after signing the DCFTA part of the Association Agreement. Doing this based on elaborated previous methods is constrained by up-to-date "core" NTBs data inaccessibility for Ukraine as well as the more complex nature of the institutional approximation under way for Ukraine, which extends beyond rule-of-thumb decrease of TBTs and resembles in its magnitude more the adjustment undertaken by the NMSs. I, therefore, employ a more direct regression discontinuity (RD) approach (or design as it equivalently called) to estimate the treatment effects on exports from

institutional change for the NMSs and further apply these estimates to the Ukrainian trade data to predict the new trade flows from such institutional harmonization happening in Ukraine.

The choice of RDD is based on its several attractive features, such as minimum assumptions required for identifying the mean treatment effect for a subgroup of population as well as advantages concerning model specification in terms of bypassing the concerns of which variables to include in the model and in which functional forms (Hahn and van Der Klaauw (2001). Generally, the limitations of this approach stem from the localized nature of the parameter of interest, which identifies the treatment effect locally at the point with discontinuity in the probability of receiving the treatment. However, in our case it is specifically this local point of discontinuity of exports due to the legal approximation that I am interested in thus further highlighting the neatness of approaching the research aim through this econometric approach, whose specifics and theoretical background I now investigate in more depth.

5.2 Regression discontinuity design

The RD design has been gaining more and more attention in the modern econometric works. The applications vary from the effects of eligibility for financial aid on the college enrollment decision (van Der Klaauw, 2002) to the effects of air pollution on infant health due to the Clean Air Act (Chay and Greenstone, 2005). Hahnand van Der Klaauw (2001) explored the issues of identification and estimation. McCrary (2008) offered tests for ensuring validity of the design and Frölich (2007) covered the inclusion of covariates. Several studied provided detailed overviews of the design (Lee and Lemieux, 2010; van Der Klaauw, 2008).

The RD was introduced for the first time in the work of Thistlethwaite and Campbell (1960), who analyzed the effects of merit awards on several academic outcomes. The key point of the method was that the students have been awarded based solely on their test scores. Those who scored equal or higher than a certain test threshold "c" were awarded, while all those that did not pass this threshold were not. This assignment mechanism into treatment implies that there is discontinuity in treatment - receiving the merit award, as a function of the forcing variable X – test scores. Such treatment is commonly denoted by the dummy variable $W \in \{0, 1\}$. Thus, $W = 1$ if $X \geq c$ and $W = 0$ if $X < c$. This is the Sharp Regression Discontinuity (SRD) design with treatment a deterministic function of the assignment variable X_i, $W = f(X_i)$, where X_i takes a range of values and its point c where the function $f(X_i)$ is discontinuous is assumed to be known.

Alternatively, there exists the Fuzzy RD design where the treatment is a random variable given the X and thus not a deterministic function of the X. It is the conditional probability of receiving treatment in this case that is also discontinuous at c,$f(X) \equiv$

$E[W_i|X_i = X] = Pr[W_i = 1|X_i = X]$(Hahnand van Der Klaauw (2001). I will apply the Sharp Regression Discontinuity design in our case since the process of alignment to the EU's *acquis* commenced at a precise time following the execution of multiple Chapters of specific legal provisions finalized and adopted in the Accession Treaty. The overall RDD method is also warranted in our case, since it allows for the outcome variable (exports) to be related to the assignment variable (year), unlike to a certain instrument in the case of Instrumental Variables approach (van Der Klaauw, 2002).

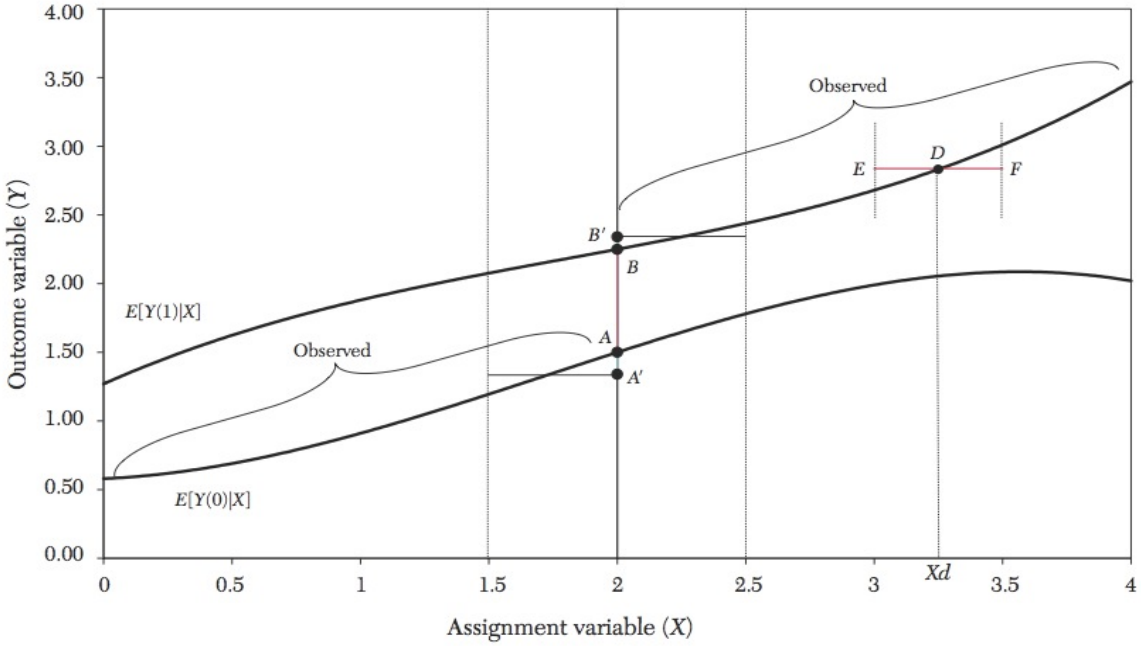
For SRD design as summarized by Lee and Lemieux (2010) there would seem to be no other reason than the treatment to have the discontinuous effect on the outcome of interest. With this in mind I can attribute the discontinuous jump in outcome variable Y at the threshold c to the causal effect of the treatment.RD further assumes that all other than treatment factors are continuous with respect to the assignment variable. In this case the points closest to the threshold on both sides of it that is just a little smaller or larger than cutoff value c are comparable. A unit just below the threshold is a valid counterfactual for the unit just above it and would represent what would have happened to the unit just above threshold have it not received the treatment. In this case the difference in the variable of interest between these two units represents the causal estimate. Therefore, the RD design focuses on just the effect around the threshold. Yet, one cannot use solely the observations at the threshold as this would typically leave too few data points. Examining anything closer to the cutoff c than the points just below the threshold or just above would be unreasonable. Therefore, in order to approximate the treated and untreated states at the cutoff with limited data it is necessary to use the data further away from the threshold on both sides. Then, if the functional form of the data is linear, OLS estimator of the treatment dummy variable W would present the best linear unbiased estimate of the treatment effect τ as represented in a simple equation of the form:

$$Y = \alpha + \tau W + \beta X + \varepsilon \quad (6)$$

The RD design has been presented in the language of potential outcomes framework and treatment effects by Hahn, Todd, and van der Klaauw (2001). The potential outcomes framework developed by Rubin is called the Rubin Causal Model (RCM) and became the dominant framework in the program evaluation literature for analyzing the causal effects. Given the goal of estimating the effects of W – specific treatment on Y – variable of interest, the RCM claims that for each same individual i there are two "potential" outcomes. $Y_i(1)$ is the outcome in case the individual is treated and $Y_i(0)$ if it isn't. The causal effect of the treatment is the difference of this pair of outcomes$Y_i(1) - Y_i(0)$. The identification problem appears since the same individual can, however, be either exposed or not to treatment at the same time, thus, realizing only one of the "potential" outcomes. It is therefore possible to estimate $Y_i(1) - Y_i(0)$ for the sub-populations rather then for specific individuals.

As illustrated by Lee and Lemieux (2010, p.288) and depicted in Figure 8, one can show two relationships of the average outcome and the assignment variable: $E[Y_i(1)|X]$and $E[Y_i(0)|X]$.By construction in the RDD those to the left of the cutoff are not subject to treatment and we can observe only the $E[Y_i(0)|X]$, while those to the right of the threshold are treated and depict only the $E[Y_i(1)|X]$.

Figure 8 Potential outcomes framework in the RDD



Source: Lee and Lemieux (2010, p.288)

Therefore, estimating the treatment effect would result in:

$$B - A = \lim_{\varepsilon \downarrow 0} \mathrm{E}[Y_i|X_i = \mathrm{c} + \varepsilon] - \lim_{\varepsilon \uparrow 0} \mathrm{E}[Y_i|X_i = \mathrm{c} + \varepsilon], \qquad (7)$$

which in turn infers:

$$E[Y_i(1) - Y_i(0)|X = c] \qquad (8)$$

This represents the "average treatment effect" at the cutoff c. The continuity of the functions of $E[Y_i(1)|X]$and $E[Y_i(0)|X]$ are needed here to make the inference that those just above the cutoff are a valid counterfactual for those just below the threshold. As argued by Heckman, Lalonde, and Smith (1999) RD in fact also represents "selection on observables", in particularly matching at one point. It must thus also comply with the key requirement of selection on observables – unconfoundness. This assumption stipulates that treatment has been randomly assigned conditional on observables. Generally this would be questionable since it presumes that are no omitted covariates in the regression that are correlated with the treatment dummy and the outcome. In RDD, Lee and Lemieux (2010,

p.289) argue, however, that this assumption is more of less confirmed because "when X ≥ c, the treatment dummy is always equal to 1, when X < c, treatment dummy is always equal to 0. Conditional on X, there is no variation left in treatment dummy, so it cannot, therefore, be correlated with any other factor".

Following the Lee and Lemieux (2010), for RD to be an appropriate approach in our case it is important to that all other unobservable factors be "continuously" related to the assignment variable so that the "continuity" assumption would hold. While as shown to hold for baseline covariates in the previous section in general it is a quite ambitious assumption since the inflow into treatment is proxied in our case by the assignment variable of a year. The assumption holds when the stochastic error component to the assignment variable is continuously distributed. This is the case when the units cannot manipulate the assignment variable and locate themselves just above the threshhol. The NMSs in our case could not have indeed influence the year of the institutional change as this was the result of the complex multiparty negotiation and ratification political process, which was formally proved by the frequency distribution of the assignent variable. Additionally, the obtained treatment effect can only be generalized to the subpopulation at the threshhold, which is enough in our case since I will apply this effect also at the threshhold for Ukraine.

Furthermore, the assignment variable X in ur case is not continuous but a discreet one. This has several implications studied by Lee and Card (2008). They argue that with the discrete assignment variable one can't compare the outcomes in very narrow bins just to the sides of the threshold. It is required to run a regression in order to obtain conditional expectation of the outcome at the threshold through extrapolation. This is surely not an issue as extrapolation is required to a certain level even in the case of continuous variables.

5.3 Identification and estimation

In Chapter IV I have has provided several pieces of evidence for the validity of the identifying assumptions stipulated in the Section 5.2. Firstly, we have seen that there appear to be no discontinuities in the trends of exports versus the assignment variable in other places. This speaks against the possibility of other factors having an impact on the exports, which could be erroneously attributed to the treatment effect at the threshold. Secondly, the assumption of continuity of the assignment variable is confirmed through the constant frequency, which denies the possibility of sorting just after the threshold. Thirdly, there has not been seen a discontinuity in the selected covariates around the threshold, which may have caused the discontinuity in exports.

I am interested in examining the discontinuity in the values of exports associated with institutional harmonization. Therefore the outcome variable concerns exports of previously determined product categories. For the estimation I express the dependent

variable in natural logarithms for convenience and to have appealing interpretations. As discussed by Wooldridge (2009) the use of natural logarithms for dependent variables is warranted since they often satisfy the classical linear model assumptions more closely than models using the levels of a variable. Additionally, the log forms can mitigate or even eliminate issues of heteroskedasticity or skewedness, which are often present for strictly positive variables. The goal of our RD estimation is to measure the jump of the expected exports Y at the threshold X_0 (year 2003). Employing the sharp regression discontinuity, the basic model is of the following log-linear form:

$$\boldsymbol{Ln(EXP)_{it} = \alpha_0 + \tau W_{it} + \beta_0(X_{it} - X_0) + \beta_1 W_{it}(X_{it} - X_0) + \beta_2 TAR_{it} + \sum_{i=1}^{N} \gamma_i CD_{it} + \epsilon_i} \qquad (9)$$

This equation is estimated for all five categories of products for the panel data of t = 14 time periods for countries i = 1, … 8. The interceptα_0 shows the change in exports that would occur regardless of other variables. Parameters β_0 and β_1 cover the direct effects of the assignment variable X_i on average logarithms of exports. They represent the slopes of the trends before and after the cutoff. Parameters γ_i are regressors for eight country dummy variables CD_i, which will be used in examining the variation in the effects across countries. The variable TAR represents preferential tariffs applied by the EU-15 to the NMSs. It is included to account for the discussed potential effect of the tariffs my model. The coefficient of interest is τ, which measures the effect of the treatment W_{it}at the threshold X_0. It represents the estimated discontinuity at the cutoff.

One could also run two separate regressions on both sides of the cutoff and obtain the treatment effect as the difference of the intercepts of the two regressions. However, the advantage of applying the pooled regression model specified in equation (9) is that it allows directly obtaining the coefficient of interest τ as well as standard errors, as highlighted by Lee and Lemieux (2010).Since the heart of the issue is the correlation between the outcome and the assignment variables it is therefore important to introduce several specifications to the basic model to properly reflect this correlation and to check the robustness of the results. The first set of sensitivity analysis covers the straightforward comparison of the averages as well as global approximation to the regression function being the second order of polynomial applied to the full data set. Despite graphical evidence in favor of the linear functional form, it is worthwhile to apply different orders of polynomial to choose the most appropriate one for the given data. Another sensitivity analysis implies inclusion of the baseline covariates to see whether the estimate of the treatment effect and the standard errors will differ in an important way potentially indicating possible manipulation of the assignment variable resulting in the discontinuity of the baseline covariates. Due to the assumption of continuity, inclusion of the baseline covariates disregarding how much they are correlated with the outcome variable should not significantly affect the estimate of the treatment effect. Lee and Lemieux (2010, p.333) show that "the inclusion of these regressors will not affect the consistency of the estimator

for τ''. Two additional specificaions are applied with shorter time spans to give more weight to the observations closer to the threshold I am interested in. This, however, naturally limits the dataset thus posingrisk of affecting the precision of estimates. Therefore, these former specifications serve a comparative purpouse to check whether the observations further away from the cutoff effect the treatment effects significantly.

CHAPTER VI – RESULTS AND DISCUSSION

This Chapter discusses the estimated results from the main econometric model and its specifications. It also argues for the choice of the final specification and offers some statistical tests for robustness as well as overall validity of the design. Based on the selected model, I will also look at the differences in the treatment effect among the countries to see how the estimates of the growth in exports vary depending on the sub-samples of countries. Ultimately, based on the estimates and previous data for Ukraine I will compute the predicted exports for the defined trade–inhibited food categories.

6.1 Summary of econometric model estimates

This section reports the findings from the econometric model in the equation (9) for estimating the effects of the institutional change prompted by the EU accession on the exports of the previously impeded from trade meat and dairy products from the NMSs. Table 4 presents the estimates of the treatment effect from different model specifications. The first column presents the findings from the basic model represented by equation (9). The second column reports the treatment effect from comparing the average export values prior and after the threshold. Column 3 represents the model with the second-order polynomial of the term $(X_{it} - X_0)$ from the basic model. Column 4 reports the estimate for the treatment effect from the main model with included covariates and columns 5 and 6 explore the estimates of the models with restricted span of the used observations closer to the threshold.

Based on the log-linear model specification with the outcome variable as the natural logarithm and the dummy treatment variable of interest moving from 0 to 1, the effect of the treatment dummy is associated with $100 \times (\exp(\tau) - 1)\%$ changein the export value of the respective commodity group (Giles, 1982). However, even looking at the estimates of the τ coefficient, we can see that the category of bovine animals reveals the greatest treatment effect among all products in all model specifications. The coefficient from the column 1 implies 734044% increase in exports of bovine animals, ceteris paribus. Furthermore, the quadratic model for these products shows an even larger effect in contrast to the comparison of means. The model with covariates is of comparable magnitude to the two former ones, yet it faces very high levels of multicorrelation, hence its results may be biased. Due to the downward trend of the exports of this category prior to the cutoff, limiting the sample to only 10 years results in a smaller effect compared to the basic model.

The next category of bovine meat follows in the magnitude of the effect. Similarly to the graphical evidence in Chapter IV. The basic model estimate shows a 6519% increase in bovine meat exports around the cutoff. Restraining the samples also results in decreased estimates, while the covariates model shows the smallest coefficients.

Table 4 Estimates of the treatment effect

Specification	(1)	(2)	(3)	(4)	(5)	(6)
			1. Bovine animals			
Treatment effect	8,90	7,22	6,60	7,07	9,03	8,08
	(2,61) ***	(1,72)***	(4,71)	(2,12)***	(2,74)***	(2,56)***
Polynomial order	1	0	2	1	1	1
Sample (years)	∞	∞	∞	∞	12	10
Control variables	No	No	No	Yes	No	No
Observations	112	112	112	112	96	80
Adj. R^2	0,62	0,60	0,61	0,71	0,62	0,63
			2. Bovine meat			
Treatment effect	4,19	3,47	3,22	3,00	4,06	4,00
	(1,83) **	(1,17)***	(3,81)	(1,48)*	(1,74)**	(1,48)***
Polynomial order	1	0	2	1	1	1
Sample (years)	∞	∞	∞	∞	12	10
Control variables	No	No	No	Yes	No	No
Observations	112	112	112	112	96	80
Adj. R^2	0,60	0,58	0,59	0,69	0,60	0,61
			3. Raw milk and dairy			
Treatment effect	0,95	1,45	0,76	1,04	1,14	1,07
	(0,28)***	(0,19)***	(0,59)	(0,30)***	(0,28)***	(0,34)***
Polynomial order	1	0	2	1	1	1
Sample (years)	∞	∞	∞	∞	12	10
Control variables	No	No	No	Yes	No	No
Observations	112	112	112	112	96	80
Adj. R^2	0,84	0,83	0,84	0,87	0,84	0,83
			4. Meat products			
Treatment effect	1,45	1,96	1,50	0,72	1,57	1,62
	(0,46)***	(0,55)***	(1,21)	(0,29)**	(0,42)***	(0,50)***
Polynomial order	1	0	2	1	1	1
Sample (years)	∞	∞	∞	∞	12	10
Control variables	No	No	No	Yes	No	No
Observations	112	112	112	112	96	80
Adj. R^2	0,87	0,87	0,87	0,91	0,87	0,88
			5. Animal products			
Treatment effect	1,84	1,70	1,37	1,90	1,88	1,79
	(0,41)***	(0,32)***	(0,79)*	(0,45)***	(0,44)***	(0,42)***
Polynomial order	1	0	2	1	1	1
Sample (years)	∞	∞	∞	∞	12	10
Control variables	No	No	No	Yes	No	No
Observations	112	112	112	112	96	80
Adj. R^2	0,88	0,88	0,88	0,91	0,88	0,87

Notes: Arellano robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Source: Own calculations based on Comext, WITS, FAO, WB

Alike all other products the quadratic specification does not provide statistically significant estimates further leading to favor the basic model. The category of milk and dairy goods depicts the smallest estimates in all specifications except the one with covariates. These findings are in line with the fact that the EU has had a milk quota system in place since 1984 after the mounting surplus beginning in late 1970s. Despite arguments against it such restricted expansion of milk production and inhibited access of the EU to growing export markets, the revision of the system in 2003 lead to a decision to retain it under the Luxembourg Agreement until 2014 or 2015 as well as to revise the system again in 2008 (Binfield, Donnellan and Hanrahan, 2008). The NMSs joining the EU in 2004 had to comply with the arranged milk quotas for them as part of the accession process, therefore, limiting the potential export gains from adapting European standards. Additionally, several transition periods have been designated for the milk and dairy produce preventing it from full access to the EU's market.

The meat and animal product groups estimates of the treatment effect from the basic model translate into 327% and 531% respective increase in exports of these goods. The estimates from the animal products category are most uniform throughout all the specifications.

Overall, the impressive magnitude of the estimated effect in percentage points for all the product groups is not surprising. Firstly, we have to bear in mind that these are products previously not traded or traded in very small quantities and have thus very large scope for growth. Secondly, the category exhibiting highest growth - bovine animals - refers to mostly live animals compared to other groups with a higher share of processed goods. Therefore, the live animals produce may gain more due to standards conformation since it has been subject to more stringent export requirements and documentation previously. This reasoning is further supported by the previous analysis by Ecorys and CASE-Ukraine (2007), which argues that the largest export value increases occur in sectors with most room for trade liberalization, given that a country has a comparative advantage in these sectors.

6.2 Model choice and sensitivity analysis

6.2.1 Functional form selection

When several polynomial models are considered one has to determine which order of polynomial is more appropriate for the given dataset. On one hand the graphic representation of the outcome of interest in Figure 5 indicated a good fit of the first order polynomial model. On the other hand some formal criteria are also useful in decision-making. An approach of cross-validation used in non-parametric estimations can also be used in our case. It is well known and called the Akaike information criterion (AIC) for model selection.

$$AIC = N \ln(\hat{\sigma}^2) + 2p \quad (10)$$

with $\hat{\sigma}^2$ being the squared error of the regression, p the number of parameters (order of polynomial plus the intercept). In our case for models of first, zero, and second order of polynomial the AIC are as presented in Table 5.

Table 5 Assessing nonlinear functional forms

AIC of product categories	1st- order polynomial	Zero - order polynomial	2nd - order polynomial
Bovine animals	639,10	641,07	642,74
Bovine meat	538,56	542,17	542,21
Raw milk and dairy	138,82	148,54	142,53
Meat products	321,32	319,27	325,29
Animal products	198,95	205,55	201,62

When comparing the first, second and zero order polynomial models the optimal specification is suggested by the lowest AIC. The first order polynomial model has the lowest one for all product categories except for the meat products group. This confirms the visual prediction of the goodness of fit of this model.

6.2.2 Testing econometrical model

When applying the Ordinary Least Squares (OLS) estimator to the basic specification (1) for the given sample of observations it must be controlled that the Gauss-Markov assumptions be met in order for OLS to be the Best Linear Unbiased Estimator of the whole population.

$$E(\hat{\beta}_i) = \beta_j, j = 1,2 \dots N \quad (11)$$

These assumptions are as follows (Wooldrige, 2009):

1) The stochastic process follows a model that is linear in parameters;
2) No perfect collinearity: in the sample none of the independent variables is constant and there are no exact linear relationships among the independent variables;
3) Zero conditional mean:For each time period the expected value of the error term is zero given any values of the explanatory variables for all time periods;
4) Homoskedasticity: the error term has the same variance given any value of the independent variables for all time periods;
5) No serial correlation: the error terms in two different time periods are uncorrelated conditional on the independent variables;
6) The error terms are distributed normally, identically and independently of explanatory variables.

Table 6 presents the findings from the conventional tests applied to testing these assumptions for the selected linear model specification. The White test has been applied to test the hull hypothesis of homoscedasticity. It involves adding the squares and the products of all explanatory variables present in the model. The p-value from the test reveals under which degree of confidence the null hypothesis of homoscedastic errors can be rejected.

Table 6 Test results of the linear model specification

	Bovine animals	Bovine meat	Raw milk and dairy	Meat products	Animal products
White test, p-value	0,003	0,063	0,004	0,0003	0,003
VIF, W	7,25	7,87	8,09	7,25	7,26
VIF, $(X_{it} - X_0)$	15,16	15,69	14,22	14,50	14,55
VIF, $W\ (X_{it} - X_0)$	8,37	8,26	8,74	8,25	8,66
Durbin Watson, p-value	6,33e-11	1,28e-06	9,71e-14	0	0
AR order 1, t-stat.	5,27***	2,99***	7,26***	9,76***	20,96***
AP order 2, F-stat.	22,42***	12,59***	31,98***	59,90***	46,09***
FE test, p-value	1	1	1	1	1
Breusch-Pagan test, p-value	0,04	0,04	0,04	0,04	0,04

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.Source: Own calculations.

A presence of heteroscedasticity at 1% and 5% significance level can be seen to occur for the given panel data. The Variance Inflation Factor (VIF) is presented to provide supplementary inside on the potential multicollinearity. According to Wooldrige (2009) the VIF is determined by correlation between each of the independent variables and the others. It represents a factor by which the variance is higher in case of correlation among the variables. Aiming for the lower VIF is impossible if the variable in question is required for inferring causality, which is my main interest. Determining the threshold for the VIF, above which one can conclude multicollinearity as impeding, is arbitrary, although the value of 10 is most often chosen. Yet, as argued by Wooldrige (2009, p.99) "a VIF above 10 does not mean that the standard deviation of the estimate is too large to be useful because the standard deviation also depends on variance and the total sum of squares, and the latter can be increased by raising the sample size. Therefore, just as with looking at the size of R-squared directly, looking at the size of VIF is of limited use, although one might want to do so out of curiosity". In our case of the independent variables being functions of years, it is not surprising that a level of collinearity above the conventional would occur for these variables. The country dummies showed VIF of only 1,75.

As for detecting presence of serial correlation both the Durbin-Watson test for strictly exogenous regressors and the test with general regressors in case of non-strictly exogenous regressors are applied. For the later one of type 1 serial correlation (AR1) one first computes the residuals from the basic model. These residuals are later regressed against the independent variables and the lagged residual so as to obtain the coefficient for the lagged residual and it's t-statistic for rejecting the null-hypothesis of zero correlation between the residual and lagged residual. A similar procedure follows for the AR2 where I include additional lagged residual of degree 2. For AR2 I look at the F-statistic to test the null hypothesis that both lagged residual variables are jointly zero. Both tests show the presence of serial correlation, which I will have to account for when estimating the errors. Appendix II further presents the density of residuals for the five product groups, which follow a normal distribution apart from the bovine animals and bovine meat categories.

Overall, evidence of heteroskedasticity and autocorrelation (HAC approach) are quite common for the panel data, since it has both time-series and cross-section dimensions(Cottrell and Lucchetti, 2014). The robust estimation of the covariance matrix must thus account for the special features of the panel data. According to Cottrell and Lucchetti (2014) these issues include the variance of the errors being different among cross-sectional units; their non-zero covariance in each time period and autocorrelation in case the "between" variation is not removed, meaning that the mean error for a specific unit may be different from that of another unit. The later one is of particular relevance in the pooled OLS estimation as the one undertaken here.The applied econometric package Gretl provides two robust covariance estimators for panel data. Only one of them, however, accounts for both, heteroskedasticity and autocorrelation. The estimator was put forward by Arellano (2003). It is HAC provided the panel is of the "large n, small T" variety meaning that many units in relatively fewer periods, which is the case of applied dataset. Cottrell and Lucchetti (2014, p.144) show this Arellano estimator to be:

$$\hat{\Sigma}_A = \left(X'X\right)^{-1}\left(\sum_{i=1}^{n} X_i'\hat{u}_i\hat{u}_i'X_i\right)\left(X'X\right)^{-1} \quad (12)$$

where X represents the matrix of regressors, $\hat{u}_i$is the vector of residuals for unit i, and n is the number of cross-sectional units. Further arguments for using this estimator have been provided by Cameron and Trivedi (2005) who note that the ordinary White heteroskedasticity-consistent covariance matrix estimator fails to take autocorrelation into account and can thus provide too small standard errors in the panel data setting.

Finally, I have computed the panel diagnostics to check whether the fixed effects or the random effects models would be more appropriate for my data. The high p-value from the test for joint significance of differing group means when applying fixed effects estimator counts in favor of the null hypothesis that the applied pooled OLS model is

adequate, compared to the fixed effects. The low p-value from the Breusch-Pagan test statistic also suggests that pooled OLS is preferred to the random effects alternative.

6.2.3 Optimal bandwidth selection

For an RDD the choice of optimal bandwidth is also relevant. On one hand, using the bigger bandwidth yields more observations thus providing more precise estimates. On the other hand, with a larger bandwidth it is more likely that the chosen linear specification will not hold introducing a bias into the estimate of the treatment effect. Hahn, Todd, and van der Klaauw (2001) demonstrate that the optimal bandwidth is proportional to $N^{-1/5}$, representing a rather slow rate of convergence to zero. In determining the optimal bandwidth there are two main approaches: ad hoc methods and cross-validation. According to the Lee and Lemieux (2010) the first approach - the "rule-of-thumb" (ROT) characterizes the optimal bandwidth through the unknown joint distribution of all variables, components of which may be econometrically estimated and inserted into the optimal bandwidth function in kernel density estimation. For the Gaussian kernel and actual density Bernard W. Silverman (1986) have demonstrated that the closest formula to the optimal solution is $0{,}9 \cdot \hat{\sigma} \cdot N^{-1/5}$, where $\hat{\sigma}$ is the estimate of the dispersion of the assignment variable, that is the standard deviation. Furthermore Imbens and Karthik Kalyanaraman (2009) in deriving an optimal bandwidth for such a local linear RD specification introduce a method for choosing the bandwidth based on several other data requirements. I apply the ROT as shown in the initial step in Imbens and Karthik Kalyanaraman (2009) following the Silverman rule based on a normal kernel and a normal reference density to get the suggested bandwidth h as follows:

$$h = 1{,}06 \times \hat{\sigma} \times N^{-1/5} \tag{13}$$

where the sample variance of the forcing variable is:

$$\sigma_X^2 = \frac{\sum(X_i - \bar{X})^2}{N-1} \tag{14}$$

The obtained bandwidth is 0,79. It is very close to the one applied in model specifications – 1. Therefore, I choose to stick to the selected pivot bandwidth of the year as it is the closest to the optimal one given my data.

6.2.4 Validity of design

As indicated before, the RDD relies in the continuity assumption. The graphical evidence did not show discontinuity of our selected covariates at the cutoff. Yet, is it useful to also check for this statistically. A way of doing this is to plug in the covariates one by one into the model as dependent variables to see whether they reveal a significant discontinuity at

the threshold similarly to what was done with the exports variable. Table 7 shows the estimates of the treatment effect – τ from such regressions. The only covariate depicting a small statistically significant jump around the cutoff is the meat production. While the magnitude of this jump is not comparable to the large previously estimated treatment effects for the exports, this supports the previous reasoning of non-perfect suitability of this variable as a the baseline covariate, which should be predetermined prior to the assignment variable.

Table 7 Sensitivity check for the continuity assumption

Treatment effect	Bovine animals	Bovine meat	Raw milk and dairy	Meat products	Animal Products
Ln(Pop_Agri)	0,03 (0,04)	0,04 (0,03)	0,04 (0,03)	0,03 (0,04)	0,03 (0,04)
Ln(Agri_Land)	-0,01 (0,04)	-0,004 (0,04)	-0,01 (0,04)	-0,01 (0,04)	-0,01 (0,04)
Ln(Meat_Prod)	0,18 (0,08)**	0,16 (0,08)**	0,13 (0,08)*	0,17 (0,08)**	0,17 (0,07)**
Ln(Milk_Prod)	0,04 (0,03)	0,04 (0,03)	0,04 (0,03)	0,04 (0,03)	0,04 (0,03)

Note: Robust standard errors in parenthesis. * significant at 10%, ** significant at 5%, *** significant at 1%
Source: Own calculations

However, overall the test confirms the assumption of continuity that is that there has been nothing else than the treatment occurring around the threshold that may have significantly influenced the growth in exports via the effects on baseline covariates.

6.3 Heterogeneity analysis

Exploring the heterogeneity of the treatment effect is of particular interest in this thesis. Firstly and most importantly, the method for predicting the growth of Ukrainian exports from institutional change is based on the evidence from the similar experience of the NMSs. Secondly, since I have a small limited number of countries the impact of each of them is more profound on the estimates from the joint model. Thirdly, this contributes to the body of literature on assessment of the effects of the biggest EU accession of 2004 in terms of countries and people. To explore this variation between countries in my sample I look at the estimated coefficients of their dummy variables from the main model as presented in Table 8.

The dummy coefficients for the group of Baltic countries (Estonia, Lithuania, and Latvia) as well as Slovenia are mostly negative across the product categories. This means that in case the country belongs to this group, the change in its exports is negative compared to the intercept. The intercept refers to the effects that would occur anyways and in case all other independent variables are zero it is the expected sample mean.

Therefore I will further refer to this group of countries as "weak exporters", which is in line with what one may expect given that total meat production of these countries has been stably only around 8% of the meat production of Czech Republic, Hungary and Poland and respectively only 18% of their milk production since 1995. Furthermore, as we have seen from Table 3 in Section 4.2, the Baltic countries are endowed with less agricultural land and have the population involved in agriculture smaller by over a million people. It appears that this group of countries is particularly weaker with regard to bovine animals and bovine meat products, for which it has the biggest negative coefficients. On the other hand, Czech Republic, Hungary and Poland - referred to here as "strong exporters" - are shown to have their exports increase compared to the sample mean. Particularly, all three seem to gain comparatively most in meat products and least in raw milk and dairy product group. Overall, Poland has had the biggest increase of its exports of nearly all products groups except meat products compared to average NMSs.

Table 8 Variation in the effects on exports among countries

	Bovine animals	Bovine meat	Raw milk and dairy	Meat products	Animal products
Czech Republic	0,79	0,29	1,04	1,78	1,06
	(0,00) ***	(0,00) ***	(0,01) ***	(0,00) ***	(0,00) ***
Estonia	-8,05	-3,89	-0,01	-2,32	-0,89
	(0,06)***	(0,04)***	(0,02)	(0,06)***	(0,01) ***
Hungary	1,77	2,34	0,17	4,44	2,36
	(0,00)***	(0,02)***	(0,01)***	(0,06)***	(0,00) ***
Lithuania	-7,44	-1,16	0,76	-0,45	-0,01
	(0,07)***	(0,06)***	(0,02)***	(0,07)***	(0,01) ***
Latvia	-6,66	-4,53	-0,23	-1,49	-0,52
	(0,07)***	(0,06)***	(0,02)***	(0,00)***	(0,00) ***
Poland	2,58	3,86	1,75	4,16	2,66
	(0,01)***	(0,01)***	(0,01)***	(0,01)***	(0,00) ***
Slovenia	-3,43	1,21	-0,28	1,63	-0,61
	(0,01)***	(0,01)***	(0,01)***	(0,01)***	(0,00) ***

Note: Dummy variable for one country Slovakia excluded to avoid perfect collinearity. * significant at 10%, ** significant at 5%, *** significant at 1%. Source: own calculations

Regarding the differences in effects on exports between "strong" and "week" exporters, it is insightful to see how the overall treatment effect from the institutional change varies between the two country groups. For this I created two subsets of data for

the two country groups of those that demonstrated better than average change in exports – strong exporters - and those that showed smaller than average change in exports based on previous table – weak exporters. I then ran the main model to obtain the estimates of the treatment effect and the respective % change in exports of each product category.

Table 9 Estimated treatment effect within sub-samples of heterogeneous groups

	Bovine animals	Bovine meat	Raw milk and dairy	Meat products	Animal products
		All countries			
Treatment effect	8,90	4,19	0,95	1,45	1,84
% change in exports	734044	6519	160	327	531
		Strong exporters			
Treatment effect	1,30	1,30	1,09	0,17	1,03
% change in exports	267	267	196	18	180
		Weak exporters			
Treatment effect	13,05	6,40	0,85	2,29	2,42
% change in exports	46677278	59992	133	885	1029

Note: Strong exporters – Czech Republic, Hungary, Poland; Weak exporters – The Baltic states, Slovakia and Slovenia. Source: Own calculations

Table 9 demonstrates that for most products the group of countries with negative country dummy coefficients has enjoyed a larger effect from adjusting to the EU's *acquis*. Particularly interesting is the fact that the magnitude of this effect is biggest for bovine categories in which they have been more disadvantaged compared to the average NMS, as seen from the previous table. This leads to assume that the large overall estimates of the treatment effects from all countries particularly for bovine animals and bovine meat would be upward biased as predictors for the respective effect for Ukraine in case Ukraine enjoys a production capacity more similar to that of the bigger NMSs.

6.4 Predictions of Ukrainian exports

The method applied implies predicting the effects of institutional harmonization for Ukraine vis-à-vis the effects experienced by the NMSs from joining the EU. However, the CEECs enjoyed financial support through the Pre-accession agricultural instrument (SAPARD), which was in place during the period 2000-2006. This instrument was designed to target the long-term adjustment of the agricultural sector and rural communities in implementing the EU's *acquis* regarding the Common Agricultural Policy among other related issues. In 2007 SAPARD was replaced by the rural development section of the Instrument for Pre-accession Assistance in 2007.

Ukraine has also already received and is anticipated to get more financial and technical support from the EU. It received funds through the Comprehensive Institution Building initiative of the Eastern Partnership from 2011 to 2013, which aims at supporting institutional change associated with the signing of the Association Agreement with the EU and intended for swift institution building and regulatory approximation (EU, 2012b).In the light of the months-long turbulent events in Ukraine in 2014 the EU further agreed on a number of measures and a financial support package for Ukraine. These include at least 11 billion Euros in loans and grants from the EU budget and EU-based international financial institutions to help stabilize Ukraine's economic and financial situation, support institutional transition processes, political and economic reforms as well as inclusive development (EC, n.d.(d)). With regards to the DCFTA the European Commission is working out the potential for setting up a guaranteed annual envelope for supporting the investment into crucial sectors for modernization and adoption of the EU standards. The political part of the Association Agreement has also been signed on the 21th of March 2014, while in April 2014 the European Council adopted the European Commission's proposal to temporarily remove the customs duties on Ukrainian exports to the EU until November 1, 2014. This measure is estimated to be worth annually nearly 500 million Euros in tariff reductions, the majority of which would go to the agricultural sector – about 400million Euro (EU, 2014). The signature of the full DCFTA part is expected after the Ukrainian presidential elections and by November 2014. Since the political will seems to be in place currently from both parties of the agreement it is likely that it will be signed in 2014 or near future.

I may therefore, apply the estimated coefficients of the treatment effect from the chosen model to the most recent available trade data for Ukraine from COMEX for t= 2012. The final predictions of the change in exports are calculated as follows:

$$EXP_{\tau} = EXP_{t} \times (\exp(\tau) - 1) \quad (15)$$

The key choice is that among the treatment effect estimates. While the linear regression specification has been chosen, the heterogeneity analysis suggested dependence of the estimates on sub-samples. I, therefore, compute predicted changes in exports for Ukraine based on both the main and strong-exporter sub-sample specifications in Table 10.

Table 10 Growth in value of Ukrainian exports to the EU, million Euros

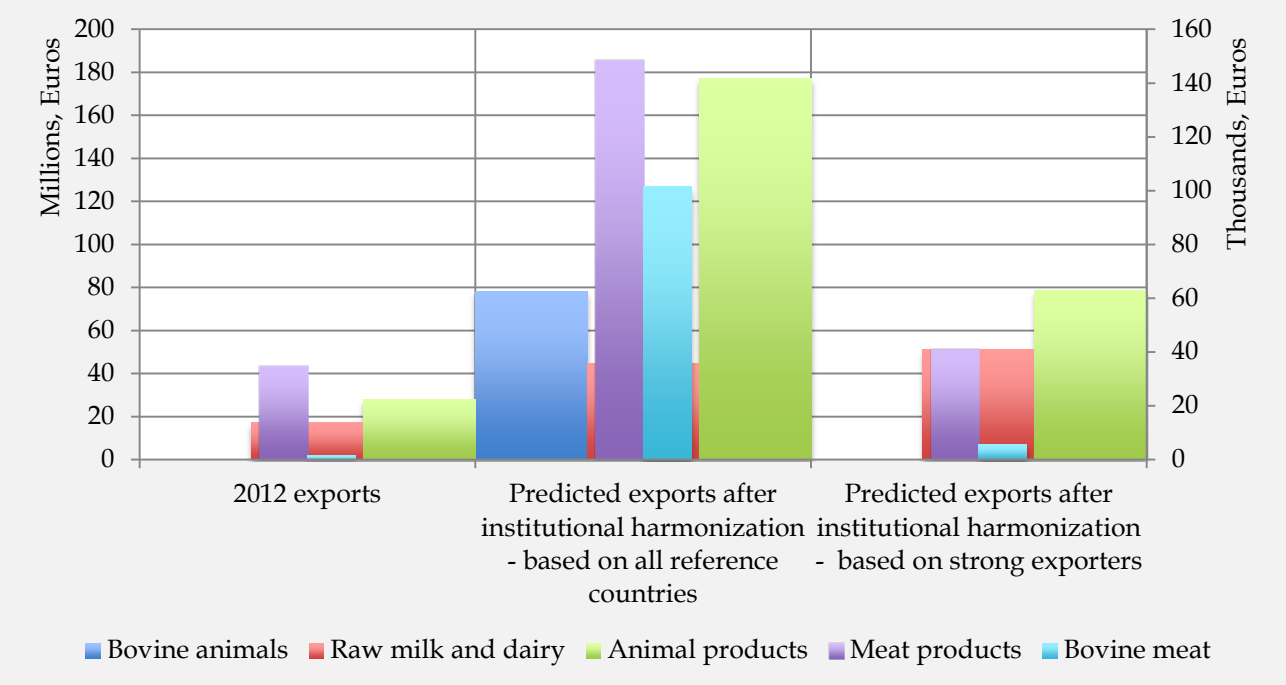
Exports change	Bovine animals	Bovine meat	Raw milk and dairy	Meat products	Animal products
Basic model	78,31	0,10	27,56	0,11	149,12
Strong exporters	0,03	0,01	33,76	0,01	50,55

Note: Strong exporters include Czech Republic, Hungary and Poland. For bovine animals category export data for 2011 has been used due to zero values in 2012. Source: Own calculations

The biggest growth in exports is predicted for the animal products category. It ranges from additional 50,55 to 149,12 million Euros. The second largest increase is anticipated for the milk and dairy produce and is of a more comparative magnitude between the two predictions, from 27,5 to 33,8 million Euros additionally. The two groups of bovine meat and meat products offer smaller gains based on the basic model of about 100 thousand Euros and nearly negligible ones based on the experience of the Eastern European States. Lastly, the category of bovine animals shows the biggest variation of potential boost in trade, from mere 28,5 thousand Euros to as much as 78,3 million Euros.

The Figure 9 puts the growth of exports into context of previous export values and shows the values of Ukrainian exports prior and after the anticipated institutional change. The largest growth occurs for animal products as well as milk and dairy products in the magnitude of millions additional Euros. This is prompted by the initial traded values larger than for the other groups, which enabled to gain more from the standards harmonization, despite the fact that the categories of milk and dairy and animal products had smaller estimates of percentage increase for the NMSs. Meat and bovine meat products are shown by slimmer bars on a secondary axis, since their levels both prior and after treatment are much smaller.

Figure 9 Predicted Ukrainian exports based on all reference countries or strong exporters



Source: Own illustration

Overall, the computations of the predicted exports of meat and dairy categories for Ukraine have shown to have tangible results as anticipated for few of the considered product groups – animal products and milk and dairy products. My estimates of growth in exports to the EU due to harmonization with the *acquis* seem to show the same

categories benefiting most from trade liberalization as compared to previous assessments using GTAP simulations. However, only few studies provided results on a disaggregated level for agriculture and mostly focused only on tariff reduction. Namely decreasing tariffs by half and including the technological change in Cramon-Taubadel et al. (2010) showed the milk and dairy products as well as animal products group to gain the most – about 139 and 64 million USD respectively. This implies that adding the non-tariff liberalization on top of the studied tariff reduction to the analysis of the DCFTA could result in even bigger gains for these two categories. Additionally, the potential largest export increase for bovine animals category is supported by the modeling results from the Ecorys and CASE-Ukraine (2007), who estimate the positive percentage change in Ukrainian exports to be most pronounced in bovine animals category in the ambitious scenario with non-tariff liberalization.

CHAPTER VII – CONCLUSIONS AND RECOMMENDATIONS

I focused on the trade potential between the EU and Ukraine in the context of a long-discussed Deep and Comprehensive Free Trade Area. As a contribution to the existing body of literature covering the possible outcomes of such a policy, this thesis attempted to highlight the weakness of previous research, most of which employed conventional CGE framework for evaluations of welfare, output and other macroeconomic effects. CGE models that employ the widely used Armington specification of import demand based on nested CES functions that distinguishes a country's imports by the corresponding country of import origin extrapolate base-year trade flows to the future after policy shocks such as a tariff removal have been simulated. This may underestimate the potential effects from trade liberalization if non-tariff barriers and institutional constraints impeded trade and were the reason for zero or small exports in the base data, since the Armington specification is not capable of augmenting trade flows according to these institutional factors. I have shown this to be the case for the meat and dairy product categories exported to the EU by Ukraine, confirming the first hypothesis. Ukrainian standards, certification procedures and regulations are not in line with those of the EU, yet they are envisaged be harmonized to the EU's *acquis communautaire* due to the ambitious nature of DCFTA trailing the process undergone by the NMSs.

Bearing in mind the research question of predicting exports for Ukraine, the "small shares" issue of the CGE and data limitations concerning the NTBs, the sharp regression discontinuity design was determined as the direct method to reach established objectives while benefiting from its several advantages. Based on the theoretical foundation of the potential outcomes framework, known as the Rubin Causal Model, the RDD is gaining more and more recognition in the modern literature on policy evaluation. Focusing on the treatment effect at the threshold was suitable to obtain my predictions also at the threshold. Despite the difficulty of selecting relevant covariates, determined prior to the assignment variable, the graphical and econometric sensitivity tests proved the required assumption of continuity to hold thus decreasing the possibility of attributing other changes to the treatment effect. Exploring the advantage and intuitive nature of the RDD, it was graphically demonstrated that the hypothesis of the discontinuity in exports for the NMSs holds at the threshold of institutional harmonization and is profound for all product groups. Importantly, it has not been observed in other periods, which could have casted doubt on the inference of the treatment effect. The choice of the assignment variable - year - has been motivated by the need to proxy the evidence of the legal alignment. While somewhat restraining the number of possible observations, this assignment variable ensured absence of manipulation by the units through self-sorting after the threshold and preselecting into treatment.

In order to confirm the graphic evidence of treatment effect and the suggested linear form I applied econometric model specifications to obtain numerical estimates. The significant estimated growth in exports for dairy and bovine animal products is not all that surprising given the focus of the research on zero and small-traded goods, which were at low levels prior to EU integration and thus had a huge potential for growth. When accounting for countries with initial larger exports, the estimated positive changes were of a lower magnitude for all products except milk and dairy. The scale of the treatment effect has been robust within several model specifications of levels of polynomials and sensitivity analysis for the inclusion of covariates as well as weighing observations closer to the threshold. The estimates, while generally similar, were somewhat smaller when other characteristics were included in the model and larger when the sample of observations was restricted closer to the threshold. The results from restricted specifications were anticipated due to the decreasing trend of exports prior to treatment, especially for the bovine categories. Finally, the justified linear specification provided consistent results due to application of the HAC robust standard error estimator.

Acknowledging the country-variation, I also attempted to take into account the heterogeneity between strong- and weak-exporters in the meat and dairy sectors. In line with the general production and capacity characteristics, the Eastern European countries have benefited more than Baltic countries when compared to the average effects among all the countries. Since Czech Republic, Hungary and Poland were shown to be more representative of Ukraine the treatment effect estimates from the sub-sample of these strong-exporters have also been used for comparison of the final predictions of Ukrainian exports. The predictions, both from the main and sub-sample models, have shown that Ukraine is estimated to have the biggest gain in exports for the categories of animal products varying from 149 to 51 additional million Euros, followed by raw milk and dairy goods ranging from 27 to 34 million Euros. The estimated growth of exports in other categories of bovine goods and meat products is by magnitude smaller with gains in thousands of Euros.

With regard to potential econometric advances for this methodology, one may wish to supplement the findings by estimates from the non-parametric models such as the local linear estimation, which can be subject to further scrutiny regarding bandwidth selection. Since the scope of this research has been confined to obtaining econometric estimates of the trade flows after the institutional harmonization, the logical suggestion for further applications is to use these to augment the CGE models and to identify the broader economic effects and induced welfare changes. Additionally, more detailed cross-country and sectoral analysis is welcomed to shed light on the cost-competitiveness of the NMSs and Ukraine as the driving force in the liberalized trade regime.

All in all, the findings of the undertaken analysis seem very promising for Ukraine. The positive quantitative impacts of trade-liberalization through legal alignment as part of the European integration process confirm the prevailing scientific consensus in favor of ”deep” free trade agreements versus ”shallow” integration. The obtained results serve as additional argumentation in favor of proceeding with the signing of the Association Agreement with the EU and in particular of the DCFTA. Given the positive and significant changes for exports, Ukrainian decision-makers are invited to:

- Reaffirm political will for signing the EU-Ukraine DCFTA;
- Undertake necessary social, economic and legal reforms to enable efficient and effective alignment of Ukrainian institutions to the EU's *acquis communautaire* similarly to what has been done by the NMSs under the Copenhagen criteria;
- Actively engage relevant authorities responsible for institutional harmonization under European integration to complete the commenced but slow progress in adopting the EU standards and regulations;
- Benefit from the designated financial and technical assistance from the EU for overall economic stabilization and development of Ukraine, especially with regards to the provisions concerning implementation of the DCFTA;
- Invest in developing productive capacity even prior to signing the DCFTA agreement, particularly regarding bovine livestock production and processing, so as to maximize the potential gains from institutional harmonization;
- Focus in the schedule of alignment measures for agriculture first on the key hampering aspects for Ukrainian agricultural exporters: labeling, marking, testing and certification and then to gradually reform the whole bulk of legislature so as to minimize the cost burden associated with harmonization.

However, it is imperative that Ukrainian officials act in accordance with ethical considerations, which prompt to take decisions based on the interest of all the stake-holders: consumers and producers, and citizens of all regions with varying geo-political aspirations. All in all, the benefits of increased exports studied in this thesis as well as theoretically deemed advantages from going ahead with deep trade liberalization with the EU are prevailing. The monetary gains from increased exports to the EU as well as consequently potentially other markets would support the GDP, already dependent significantly on the agricultural sector, and minimize the losses from SPS measures often arbitrarily imposed by Russia on Ukrainian food exports, especially dairy. Better quality food products based on higher animal welfare standards and a higher degree of transparency regarding rules of origin and labeling are also ethically sound when considering the rights of consumers. Finally, internationally recognized standards and procedures are likely to attract the needed investments into the sectors, developing the production capacity to meet mounting global food pressures and enable increasing exports of more processed Ukrainian products with higher added value.

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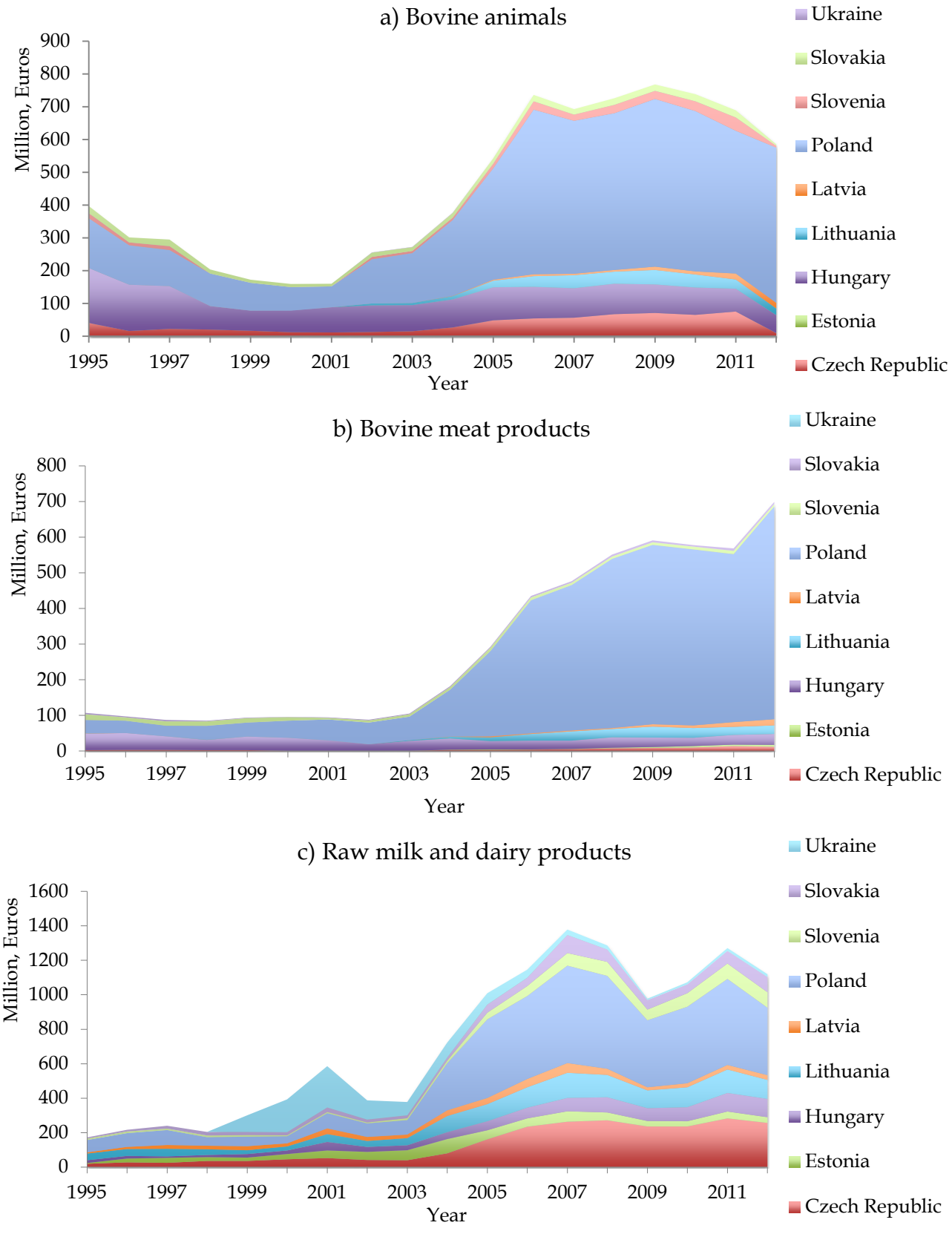
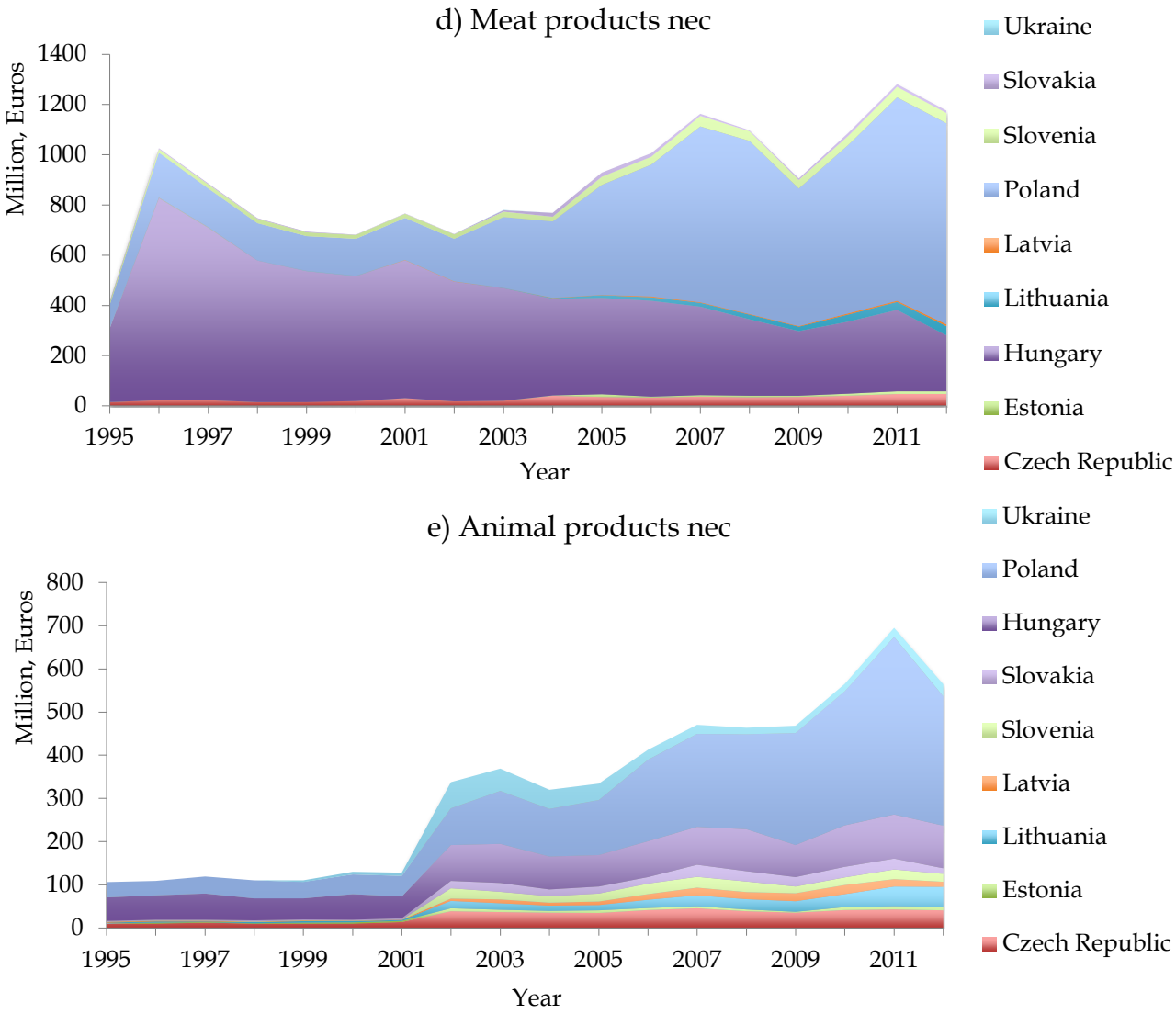
APPENDIX I

Exports of selected products

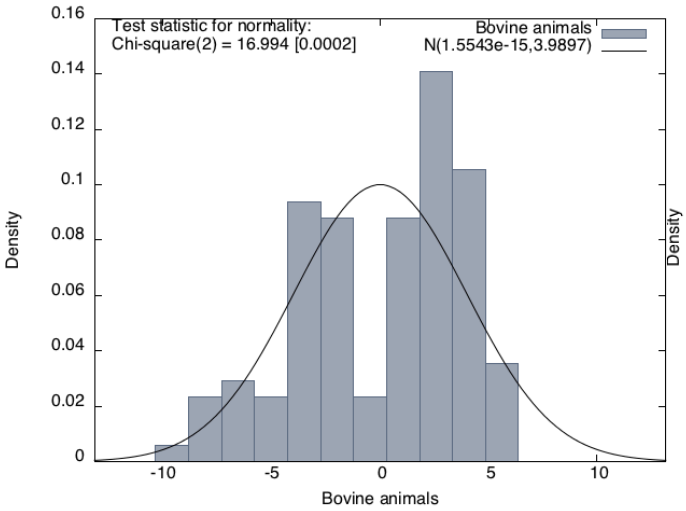


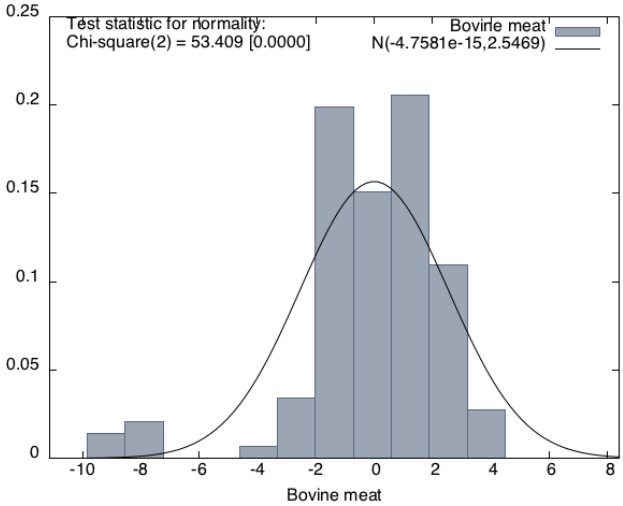


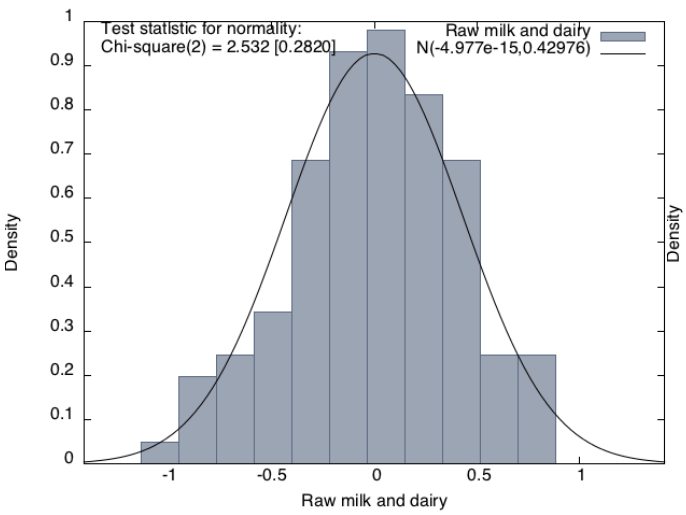
Source: Own illustration based on Comext

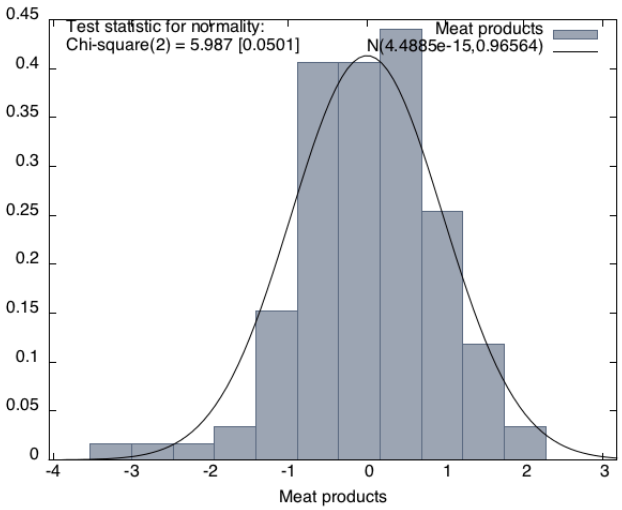
APPENDIX II

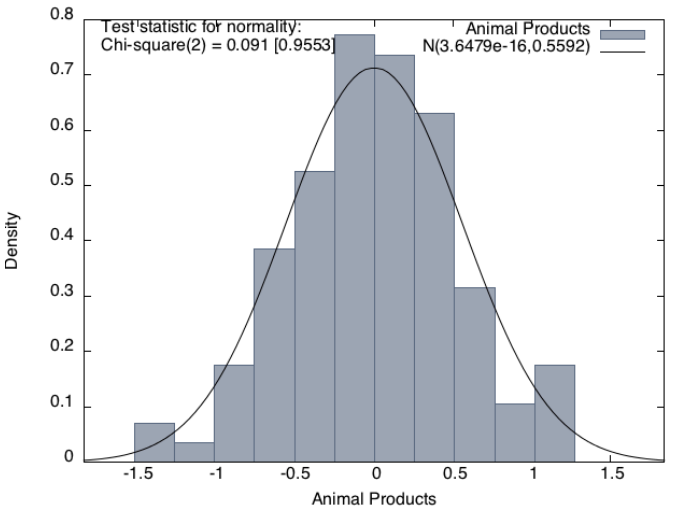
Density of residuals











Source: Own calculations